The Welding Engineer

Reg. U.S. Pat. Office

Volume XXI March, 1936 Number 3

W[illegible] rapidly becoming the stan[illegible]od employed in [illegible]cation of barges for tra[illegible]g coal on inland waterways.

(See Page 23)

NEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

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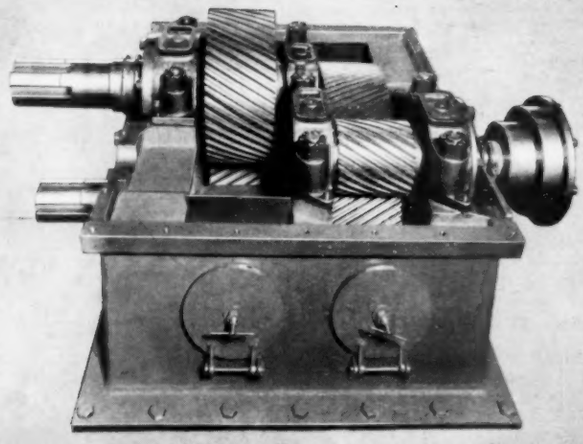
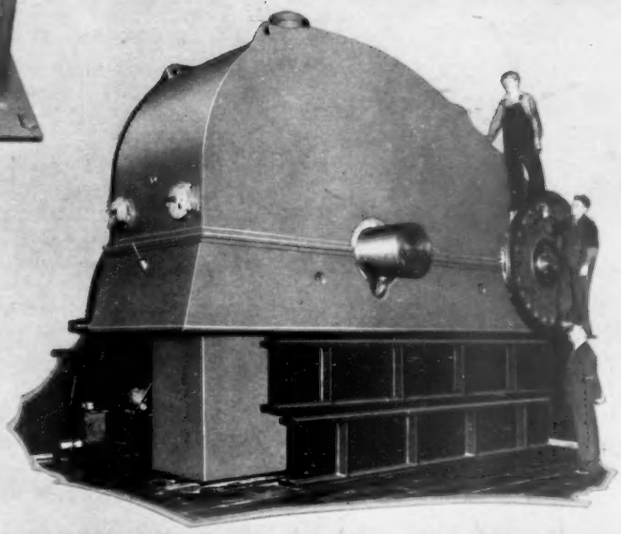
MUREX IMPROVES THE WELDING



Below — Single reduction mill drive with welded housing fabricated with Murex by the Falk Corporation, Milwaukee, Wis.



Above—Combination drive and pinion stand with welded housing made by the Falk Corporation, using Murex Electrodes.

Welding the housings of heavy gear drives provides strong, light, good-looking units. Fabrication of these housings by welding together rolled plates and steel castings also results in speedier production and economy of materials.

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THE WELDING ENGINEER

Vol. 21, No. 3 MARCH, 1936

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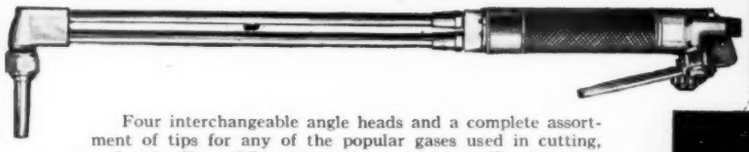

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The Welding Engineer

VOLUME XXI MARCH, 1936 NUMBER 3

Continuous Welded Steam-Road Track

Shows Good Record In Service . . .

INSTALLATIONS in this county of continuous welding of rail, in long lengths, in steam-railroad practice, do not cover sufficiently long lengths of time to enable definite conclusions to be arrived at, as regards practicability and costs. Nevertheless, there has been no excessive failure in any of these installations, and those lengths of track welded in the last year and a half have shown no failures whatever, according to the returns on a questionnaire, which is published in the progress report of a Sub-Committee on Continuous Welding of Rail, submitted at the 37th annual meeting of the American Railway Engineering Association, and given in the Association's *Bulletin* of Jan., 1936.

Reveal Important Data on Rail Welding Practice

This questionnaire gives details regarding location of the welded section, length of track welded and whether straight or curved, date installed, grade, total number of welded joints, type of weld, details of track design, cost of weld in place, traffic tonnage, whether in tunnel or open track, range of temperature, how anchored, provision for expansion, creep of rail, percentage of joint failures, trueness of joints in line or surface, saving in track maintenance, maximum wheel load, temperature when rail was laid, and other pertinent information, covering seven welded installations on steam roads and one open-track installation on a street railway. The practice of different foreign countries in the continuous welding of rail is also briefly described.

The sub-committee submits the following conclusions, arrived at after a study of the questionnaire:

"A study of the questionnaire would seem to indicate that so far in this country we have been able to weld track in long stretches in tunnels on steam roads with variations of temperature up to 75° or over without provision for expansion except that made in ordinary track, that this track is of ordinary structure with cut spikes, the usual number of ties per rail, gravel or stone ballast and single- or double-shoulder tie plates. With the more rigid type of track, such as the M&L in use on the Delaware & Hudson and the GEO in use on the Bessemer & Lake Erie, it has been possible to weld rails in lengths up to 12,000 ft. without any excessive movement either laterally or lengthwise, with a temperature change up to 125°.

"As a general thing it has been possible to butt weld rails together without excessive failure and to good line and surface, this having been standard practice on the electric roads of this country for a good many years, a large amount of it being done on the European roads for the past five or six years and on railroads in this country as shown on the questionnaire.

"The inspection by the Committee of the track on the Delaware & Hudson, especially that piece at Schenectady, convinced them that track of this type can be so welded as to allow perfect line and surface insofar as the joints are concerned.

Expect to Reduce Cost Per Mile of Welded Rails

"The extra cost of rigid construction —although in the case of the Delaware & Hudson running up to approximately $2,000 per mile over the cost of ordinary track construction on heavily traveled roads with the same weight of rail— will no doubt be reduced as time goes on in view of the fact that other similar types of track of cheaper construction are being developed at the present time.

"As to the cost of the welds, which seem high in the installation on the Delaware & Hudson, there is no question but that as further work is carried on the price on the thermit welds can be cut down considerably. In addition to this, as given above, there has already been developed in Germany a machine for the making of flash welds on rails, and there is being developed at the present time in this country a machine which is designed to make flash welds in the field with the rail in track. In addition to this, it is possible to purchase 66-ft. rails at a cost of $5.00 extra per ton and thus reduce the number of welds per mile from 270 to 160. It should be borne in mind, however, that controlled cooled rail cannot be purchased in this length at the present time.

Seven Ways in Which Savings Can Be Made With Welding

"The amount of saving which can be made in maintenance is problematical at the present time, but some of the items on which this saving is anticipated are given below:

"(1) Elimination of rail-joints.

"(2) Increased life of rails through the elimination of end batter.

"(3) Saving in labor required in relaying rail through increased life of rail.

"(4) Reduced mechanical wear of joint ties with resultant increased life of these ties.

"(5) The substitution of a standard intermediate tie plate for the larger and more expensive plates used on the joints on some roads.

"(6) More efficient track signal circuits through the lower resistance of the welded joints, saving the cost of installation and maintenance of bonds.

"(7) Reduced maintenance of rolling stock and motive power.

"In connection with the first item, in various studies which the Committee on Economics of Railway Labor have made, it has been figured that approximately 65% of the track labor is chargeable to Account 200—Track Laying and Surfacing—and that in the vicinity of 75% of this charge covers the labor used in tamping at or in the vicinity of the joint. Thus over 45% of track labor is now necessary in order to keep the rail joint in proper line and surface. It goes without saying that if this amount of labor could be saved it would off-set the cost of the continuous welding of rails.

"As against the saving shown above we have:

"(1) The increased cost of the weld over the joint.

"(2) Possible increased cost of laying rail.

"(3) The increased cost of changing out rail in case of a break, including the extra cost of the two welds required."

Underground Pipe Replaced With Welded Installation

A steam-pipeline job, involving the welding of pipe ranging from 3 to 10 in. in diameter, was recently completed by Dillon's Welding Shop, Battle Creek, Mich., for Olivet College, at Olivet, Mich. These lines furnish the heat for several of the college buildings, and were installed to replace the old flanged-and-screwed system. The latter lines were removed after 15 years of service, and were leaking badly at the joints. The new welded lines are laid in Ric-Wil tile and insulation.

A. F. Dillon, who had charge of the welding, states that he has talked the advantages of welded pipelines to his customers for many years, with the result that now it is not hard to convince them that the welded installation will save them money, and he finds that on new installations it is just a matter of adapting the welded system to the customer's needs.

Welded Steam Heating Line.

Training Courses in Metal Radiography

Two practical training courses in "Metal Radiography" will be conducted this summer by the St. John X-Ray Service, Inc., at their laboratories at 30-20 Thomson St., Long Island City, N. Y. One will be held for the benefit of those attending the A.S.T.M. meetings during the week of July 6, and the other one during the week of July 13.

Shop Builds Own Hoist for Handling Portable Welders

An all-welded electric-driven hoist has been built by H. H. Cockrum for use in his shop, which goes under the name of Cockrum Welding Service, Los Angeles, Calif. While useful for doing heavy lifting and transporting of jobs about the shop, this hoist was designed and built especially for loading and unloading the shop's portable welding units on and off trucks, which are also built and equipped especially for field work.

The hoist is operated by a ½-hp. electric motor, and it is interesting to note the ease and speed with which it elevates the heavy welding unit, the weight of which is somewhat over a ton. The supporting posts of the hoist are wide enough apart that when the unit is hoisted the proper distance, the truck can be backed under it and the welding unit slowly lowered onto the truck. A handy clamp to prevent the unit from shifting on rough roads is then connected, and the outfit is ready for the road.

The hoist is 9 ft. high and 7½ ft. wide. The base to which the wheels are secured is 6 ft. long. The main supporting posts, top and base members, are all of 4-in. locomotive-superheater tubing, with welded construction throughout. Two pieces of the tubing are used for added strength across the top, with braces from each side post, which are of 2-in. pipe.

Underneath the bottom pipe at the top is welded a 1½-in. steel bar, 18 in. long, from which is suspended the block and motor. Underneath this bar, and around and over the top of both pieces of pipe, are welded two heavy pieces of strap iron, affording necessary added strength. By heating an area of the pipe on the bottom above the center of the underneath bar, and hammering a dent in the pipe, proper space was provided for hooking the chain suspending the block and motor.

Handy Hoist for Lifting Welders.

A handy tongue, convenient for guiding and pulling the hoist about the shop, and which is easily disconnected and removed when not needed, hooks to the frame at each side of the base. The tongue is made of ⅝-in. steel rod.

Mr. Cockrum states that this hoist is absolutely fool-proof and positively irreversible, which are very important safety features; also, that the time required to lift and place his welding unit onto a truck is less than one minute.

Wants Advertising Campaign to Sell Welding

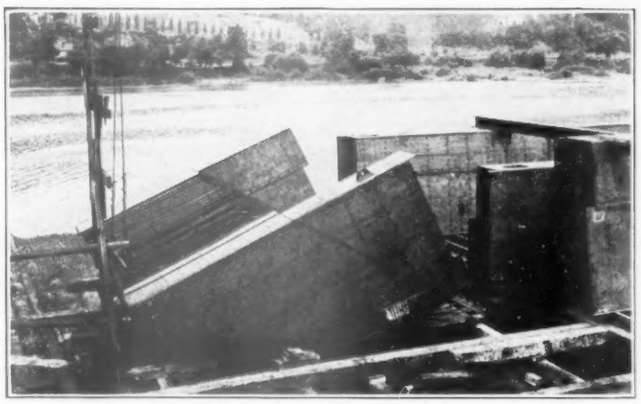
"I believe that a national campaign of advertising should be inaugurated on a large scope to acquaint the public with the possibilities of welding, as people generally have a very limited idea of what repairs and other improvements can be accomplished by welding," says Louis Klugman, president and general manager of the Klugman Welding Co., 818 East 18th St., Kansas City, Mo. "Such a campaign of education would prove a great stimulus to the trade and would result in increased consumption of welding rods and gases. I believe it would ultimately increase the volume of business fully 75%."

Regarding advertising of his own business, Mr. Klugman has found both newspapers and radio helpful, particularly newspaper advertising that covers an extensive territory. As a result of newspaper ads, his firm has received a great deal of out-of-town work from communities where there are no well-equipped welding plants. He also expresses the hope that a local section of the American Welding Society can be organized in Kansas City.

WELDS Replace RIVETS on BARGES in PITTSBURGH District

By EDWARD H. SYKES
Pittsburgh Correspondent
The Welding Engineer

WELDED steel barges for inland-waterway service, especially for the transportation of coal from the great captive mines along the Monongahela and Youghiogheny Rivers in the Pittsburgh district, are rapidly replacing riveted construction, primarily because of their greater durability, longer life and more satisfactory service. This view is shared by builders and buyers, alike; and in recent months, practically all of the larger orders have specified welded equipment.



Barge in Stage of Fabrication.
(Fabrication and assembly of the welded barge are carefully worked out to insure a maximum of efficiency. Welding is also proving highly popular in repairing damages to riveted barges.)

Welded Barges Have Several Salient Advantages

Welded barges present several salient advantages. First, they are water-tight and do not leak. Then, they withstand heavy abuse, such as the strains in coal-loading, coal being dumped from the tipples directly into them. Riveted construction will not stand such abuse any great length of time, for eventually the rivets work loose and permit river seepage. Repairs to riveted barges are invariably made by welding.

Among the half-dozen or more prominent barge builders in the Pittsburgh district is the Dravo Contracting Co., manufacturers of floating and terminal equipment of various kinds, as well as dock and material-handling installations of huge proportions. Its shipyards and marine ways are located on Neville Island, on the Ohio River, about ten miles below Pittsburgh proper, and also on the Christiana River at Wilmington, Del.

Some idea of the magnitude of the work turned out by the Dravo Contracting Co. may be had from the accompanying illustrations, which show new and improved designs of all-welded coal barges, now under construction at this plant. A fleet of barges, similar to those depicted, was recently built for the Hillman Transportation Co., of Pittsburgh, river-operating subsidiary of the Hillman Coal & Coke Co. of Pittsburgh.

Stuart D. Brown, sales manager for the Dravo Contracting Co., an enthusiastic welding advocate, said recently:

"This new coal barge incorporates a considerable number of improvements in design which show up to great advantage in actual service. Without changing the overall dimensions of the barge or its general appearance from the type which has been popular on inland rivers for the past twenty years, it is possible to reduce maintenance, lengthen the life, add considerable strength, decrease the towing resistance and increase the carrying capacity.

Welding Procedure Is Worked Out Most Carefully

"The welding method of procedure for manufacturing these units has been carefully planned and consists of accurate shop fabrication, as well as sub-assembly work of various units as a part of the fabrication scheme. Special jigs, fixtures and positioning equipment have been provided to obtain a maximum of flat-position welding for all assemblies.

"The present operators of this barge are more than pleased with the numerous advantages which have become more rapidly apparent since entering service last summer."

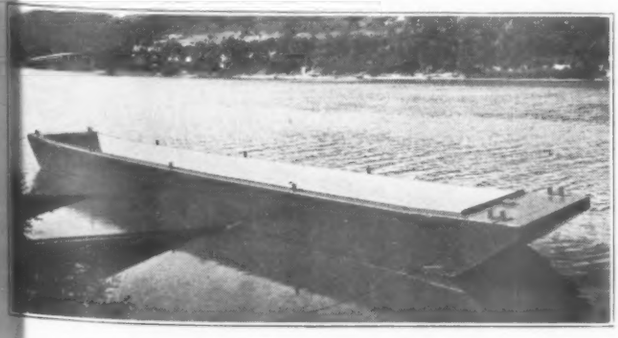
Riveted Craft Usually Repaired By Welding Process

Mr. Brown also pointed out that most of the repair work on barges in his company's shipyards is the welding of riveted craft damaged in service. "In many cases," he said, "it is not possible to repair these by riveting, as they are not in proper shape to be re-riveted."

The Neville Island yards of the Dravo organization are now engaged in the manufacture of two tow-boats for the Pittsburgh Coal Co. and one for the Monongahela & Ohio Dredging Co. of Pittsburgh. All three vessels will have welded steel hulls.

Construction work of this type involves huge tonnages of steel plates and shapes. At present the Dravo Contracting Co. has thousands of tons of unfilled orders on its books and production has been stepped up accordingly, although recent floods in the Pittsburgh territory have held up launchings.

One of the awe-inspiring sights in the great Pittsburgh industrial center is seen on a night tour of the steel manufacturing plants, and motorists driving along the boulevard across the Ohio River from the Dravo plant are impressed with the glow of welders' torches as they fabricate these enormous units.



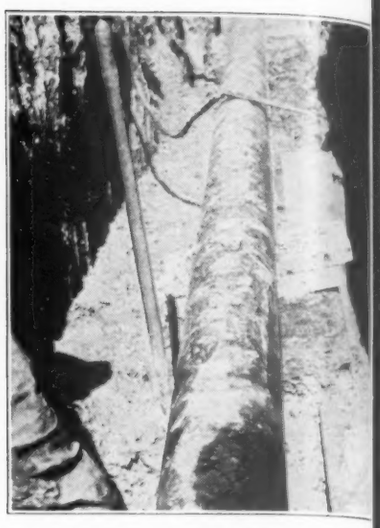
Barge Launched at Neville Island Shipyard.
(The welded barge of modern design is graceful in appearance and is built to withstand the hardest kind of usage.)

"Half-Soling"

Corroded Spots in

Underground Pipelines

∴ By ELTON STERRETT



Showing One Length Welded in Place.
(Space for placing next "half sole" marked by shovel handle.)

WELDING, already a most important tool in the fabrication of and laying of crude-oil pipelines, is indispensable when maintenance is involved. As an indication of the part welding plays in the upkeep of a vast oil field, a recent traffic count on the main east-and-west highway through the East Texas area disclosed the astonishing fact that during the period covered by the tabulation there were 102 trucks observed carrying line pipe, and 61—or 60% as many — vehicles enumerated in the same time laden with oxygen and acetylene cylinders en route to various operations or being returned for refilling.

Worm's Eye View of Corrosion.
(Taken with arc from welder's rod to lighten up dark section of pipe.)

During that same census eleven portable electric-welding units were listed, in this case the names of each (or auto license numbers when no operator's name was evident) being taken to avoid duplication through one truck chancing to shuttle through the area during the count.

Corrosion of pipe is the greatest cause of maintenance work — far exceeding that demanded by accident, floods or fire. One major oil-company's line, laid a scant four years ago, was being given a routine annual examination, when the test hole diggers chanced on a pitted, corrosion-eaten condition of the 8-in., high-carbon pipe, which appeared to demand the immediate removing of the entire damaged section and its replacement with new pipe. The original wall thickness had been reduced by more than half, in these pits, and in a number of instances the tester's knife point went through and brought traces of oil.

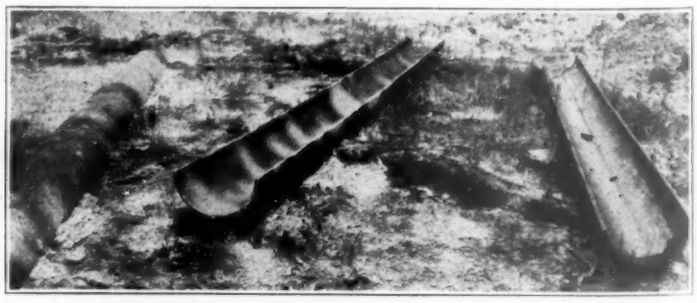
To replace this section (several hundred feet in length) would require a shut-down which would seriously delay much-needed crude deliveries, and would involve the draining off and temporary storage of several hundred barrels of expensive, volatile oil, as the bad section ran through a low, swampy terrain with high ground on both sides over which the line was carried.

Further study of the affected line disclosed the fact that practically all the pits occurred on the lower half of the pipe. Estimates were made of the probable amount of patch welding necessary to put the line again in first-class condition. After totalling the amount of welding involved, it appeared that the welders would be forced to apply more than three times as many lineal feet of weld as would be required were the entire lower half of the line covered with one big patch, seamed only at the ends and along the sides.

Suitable material for "half-soling" this line was secured by splitting longitudinally joints of standard-weight 9⅝-in. well casing with a cutting torch. These split sections were liberally coated with a corrosion-resisting dope, care being taken to maintain a clear or untouched margin of at least an inch along the sides to keep the dope away from the weld.

With sections of the line uncovered and cleared out underneath to give working room, but left remaining in the trench and supported on evenly spaced benches of earth to avoid setting up strain in the steel, care was taken to ensure a thoroughly cleaned metal, especially on the sides where the joint was to be made. Then every alternate section of the split casing, measured to fit an inch short of abutting its neighbor when the job was completed by installing sections in the gaps left, was lowered into the trench and firmly clamped against the line pipe.

Using heavy coated electrodes, the



"Half Soles" Ready for Welding to Main Line.
(The one to the right is painted with corrosion-resisting dope up to weld margin.)

Fig. 4. Close-Up of Weld.
(Note double bead reinforcing, also filled pit on upper surface.)

half soles were welded throughout their marginal contact with the 8-in. main line, a single bead being run along the longitudinal seam first and then the ends closed in, after which a second bead was run over all seams, after calking, to insure a repair which would withstand maximum line pressure, even were the pitted section of the original pipe to give way.

When the first lot of alternate sections had been welded in place, the line was carefully blocked up on these, and the earthen benches originally left to sustain the pipe were removed and cleaning of the steel completed, after which the lengths of half-soles were fitted to the gaps between those already welded on, and the repair completed.

By using the electric arc, these half soles were all attached, and such pits as occurred above the center of the pipe were filled in, without requiring even a momentary shut-down of the main line pumping station, or even a reduction of line pressure, originating under a maximum allowable of 900 lb. per sq. in. at the pumps.

Through the application of well-planned welding on this job, service was maintained uninterrupted, the cost of the repair material was but a trifle over half what would have been expended for the purchase of new pipe to replace that pitted beyond further economic service, and the original high-carbon steel was not disturbed, eliminating the danger of forming "hot spots" for concentration of pump pulsation and eventual crystallization of the metal.

One welder and helper, with a 400-ampere portable generating unit, were able to tack in place and complete beading the half soles as fast as the line could be cleared for them, a program of sections being worked out whereby blocks of earth extending up to ground level were left at intervals to prevent flooding in case of heavy rains, and at the same time reduce moving of the welding outfit more often than required by progress over the line as completed.

Work such as this outlined can be profitably undertaken by commercial welding companies, as through half-soling many lines can be protected against corrosion and electrolysis and thus made to give many years more of uninterrupted service.

Coming Events

Apr. 14-17. Knoxville, Tenn. University of Tennessee. Welding Conference.

Apr. 20-24. Chicago, Ill. Midwest Engineering Power Exposition. For information write G. E. Pfisterer, 1 N. La Salle St., Chicago.

Apr. 20-25. Houston, Texas. Oil Equipment and Engineering Exposition.

May 4-9. Detroit, Mich. Foundry and Allied Industries Exposition. Also annual convention of American Foundrymen's Association. For information write the Association, at 222 W. Adams St., Chicago, Ill.

May 16-23. Tulsa, Okla. Ninth International Petroleum Exposition and Congress. For information write Wm. B. Way, care of Exposition, Tulsa, Okla.

May 25-27. Philadelphia, Pa., The Bellevue-Stratford. Annual Convention of the Heating, Piping and Air Conditioning Contractors National Association. For information write the Association, at 1250 Sixth Ave., New York City.

June 27-Oct. 4. Cleveland, Ohio. Great Lakes Exposition. For information write Ernest Smith, 3910 Carnegie Ave., Cleveland.

Sept. 22-25. Detroit, Mich. Iron and Steel Exposition. Also annual convention of Association of Iron & Steel Electrical Engineers. For information write the Association, at Pittsburgh, Pa.

Oct. 19-23. Cleveland, Ohio, Public Auditorium. National Metal Congress. Also Fall Meeting of American Welding Society and meetings of American Society for Metals, Wire Association, and others. For information write W. H. Eisenman, 7016 Euclid Ave., Cleveland.

Get "H. O. T." on Welding

By H. O. T. RIDLON

Stranger, Beware!

That's the reaction I got the other day in a welding shop. They had a great big old press frame to weld. It must have been not less than ninety thousand years old. The shop owner had to guarantee the job. It looked easy—that is, as easy as any durn hot job ever is. But they were so positive about him guaranteeing the job we figured as how we'd better look it over mighty careful like. Well we found that it was plumb full of little cracks. So we went down where they had other machines like it in service and found that the guys using them were racking hell out of 'em to make their piece rate. It just wasn't in the cards to guarantee a job like that unless you got about the price of a new casting. We did *not* take the job!

• • •

Makes All-Welded Boats, Too

In New Haven, Conn., I ran in to see Churchward who builds electrode holders. Great guy this man Churchward, and he really is doing things in building small boats of all-welded-steel construction. Hope I'm able to get back down East again in a month or two and go back fishing with him. Maybe I can pry a long story out of him about his boats.

• • •

Ye Good Olde Days

During The Ohio State Welding Conference, Mr. Wilkinson, Kansas City manufacturer of arc welders, told me one of the prize stories of the days away back when. It seems that some crossroads blacksmith shop out of a clear sky sent him an order for an arc welder, which, of course, he shipped pronto. About ten days later he got a letter from his new customer (guess they were few and far between in those days) saying that the machine was no good and that it would not work. Well, Wilkinson knowing that it would, wired him to hold it—that he was on his way there. So he climbed into his old bus fast and started out. Upon arriving at the shop he inquired what seemed to be wrong. The smith told him that he had looked the machine over very carefully and that there wasn't any place to put the iron in. He thought that an arc-welding machine was intended to be something like his old forge.

• • •

Figures Don't Lie, But—

Regarding the Townsend plan, here are some figures I ran into the other day that are mighty interesting to me. Many of you have seen them, but for those that haven't here they are:

Population of United States	124,000,000
Eligible for Old Age Pension	30,000,000
	94,000,000
Persons working for Govt., States, Cities, Municipalities, etc.	20,000,000
	74,000,000
Under Age	60,000,000
	14,000,000
Unemployed	13,999,998
Number remaining to produce Nation's Goods	2

Only you and I—and I'm getting tired—let's go fishing!

The thought for the month: If you don't get what you like, you'd better like what you get.

Wire Mesh and Sheets Welded Without Fusion . . .

An Interview With **DR. ANTONIO LONGORIA** by **F. L. SPANGLER**
Consulting Engineer, Cleveland, Ohio
Editor, *The Welding Engineer*

NOT since the first commercial application of metallic arc welding —about 30 years ago—has a new and distinct welding process been announced to the world. It is a privilege for "The Welding Engineer" to make the first public announcement of a welding process that is new and revolutionary in idea and method. The process is performed electrically, requires only a small fraction of the heat used by other welding processes, is extremely speedy and can be used on the thinnest metals without distortion. In this interview with Dr. Longoria, the inventor of this process, some ideas of the possibilities of the method are brought out and the fundamental principle of the process is briefly discussed, though the inventor has not yet released information on the type of equipment he uses to produce the welds.

WHEN future reference works list the major welding processes, there will be a new name along with such well-known terms as are welding, gas welding, thermit welding, resistance welding and forge welding.

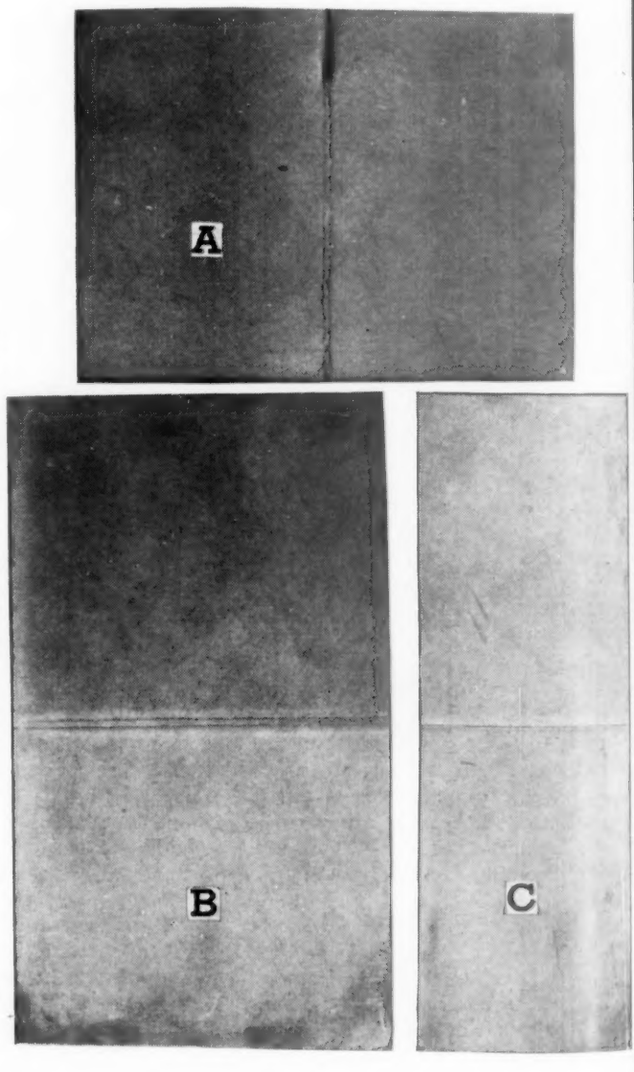
In a laboratory situated in an apartment building in one of Cleveland's residential districts, there were recently made some specimens of butt welds on thin stock of various metals, and fine wire mesh, such as no one has ever produced before. The inventor of the process is Dr. Antonio Longoria, and it was in his laboratory that the process was developed and the weld specimens made. The inventor has not given the process any name. The first weld specimens were made by this process more than two years ago, and a few welds have been shown, but the method itself has not been revealed.

Doctor Longoria's reputation as an inventor, physicist and manufacturer of scientific instruments (he once headed a successful company of his own) is an enviable one, and is world-wide. His conception of those minute particles of matter, the molecules, is not the same as we find in our elementary text books, but yet his understanding and interpretation of physical laws are based on a profound study and research over many years. Perhaps therein lies his success, and the reason why he is retained by some of the largest corporations in this country and abroad in a consulting capacity.

Before my recent visit to Doctor Longoria in his laboratory, I had already examined a weld which he had made in a fine piece of copper mesh, and it aroused my admiration and interest. Each of the fine wires was perfectly butted to its corresponding wire, and the weld showed up only as a very narrow line of discoloration along the welded seam.

I did not expect Doctor Longoria to reveal to me the means by which this welding is performed, for that must wait until some other matters have been taken care of with regard to patents on the process, but I did want to examine samples of welds made in his laboratory and obtain from him such information as might give the welding field some conception of the possible applications of the process.

Regarding the process itself, however,



Butt Welds in Thin Sheets.
(6/10 actual size.)

A. Two commercial stainless-steel sheets, 0.0113 in. in thickness. Five-eighths of an inch of seam was left unwelded at the end (top) to show that the edges are not prepared in any way.

B. Copper sheets, 0.0082 in. thick, butt welded. The thickness over the weld is 0.0087 in.

C. Copper sheet (0.0082 in. thick) welded to brass sheet (0.008 in. thick). The copper sheet is shown at the bottom.

The watts input, in making these welds, varied somewhat, but at no time did it exceed 2,600 watts.

Doctor Longoria was willing to make certain significant statements. As he speaks, he does so very precisely, choosing his words with care and avoiding technical terms wherever possible that might confuse his hearer. He wants himself understood and, therefore, is inclined to use analogies with which his hearer might be familiar.

Sitting at his rolled-top desk, located in one corner of the laboratory, he wheeled around in his chair and faced me to answer my inquiry regarding the fundamental idea back of this new system of welding.

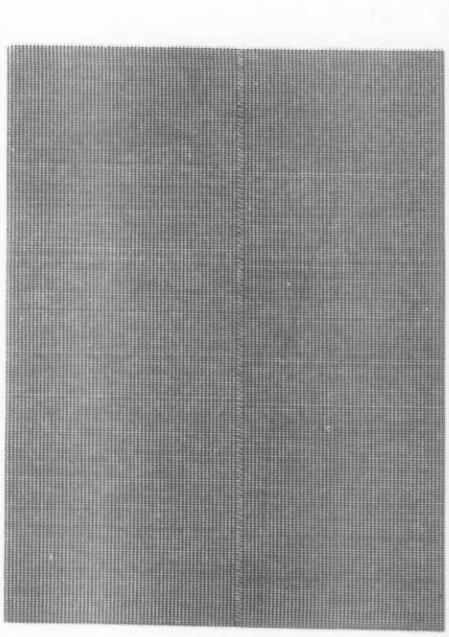
"In solid matter," he began, "the molecules are held in a fixed position at any one fixed low temperature. When we heat these molecules up to the fusion point, in the case of a metal, they become very loosely and finally disengaged, and the holding forces are no longer effective. That is what happens in the case of fusion welding.

Molecules Dislodged and Intermixed by a "Shock"

"I have found, however, when the edges of two metallic sheets are butted close together, a 'shock' will cause the molecules in both plates along the welded seam to intermingle, provided the edges of the plate along the seam first are heated to a certain temperature. In this manner," he continued, "I eliminate the joint and make both sheets as one piece.

"Let us assume a molecular structure that is horizontal. As we add heat to such a structure, its plane tips and is no longer horizontal. As more heat is added, the greater is this angle with the horizontal. With continual heating this plane rotates, and when it reaches 90° with the horizontal, the molecules are released. By my method, it is not necessary to bring the plane to its vertical position by heating, but this is accomplished by heating to a certain low temperature point followed by a 'shock' or vibration."

This explanation left me confused as to why molecules can be disentangled one from another by means of a "shock." Nevertheless, I could deduce certain significant matters that I felt the welding field would be more interested in than a treatise on advanced physics. It would seem that this method would be applicable to plates and sheets, as well as wire and wire mesh. Doctor Longoria replied that it was not. However, opening a side drawer of his desk, he brought forth a copper plate containing a seam welded by another method, applicable to plates, sheets and tubes of any metal. The welded seam may have been 4 in. long, and about ½ in. of the seam was left open and unwelded, so that one might see how the specimens were prepared and butted together.



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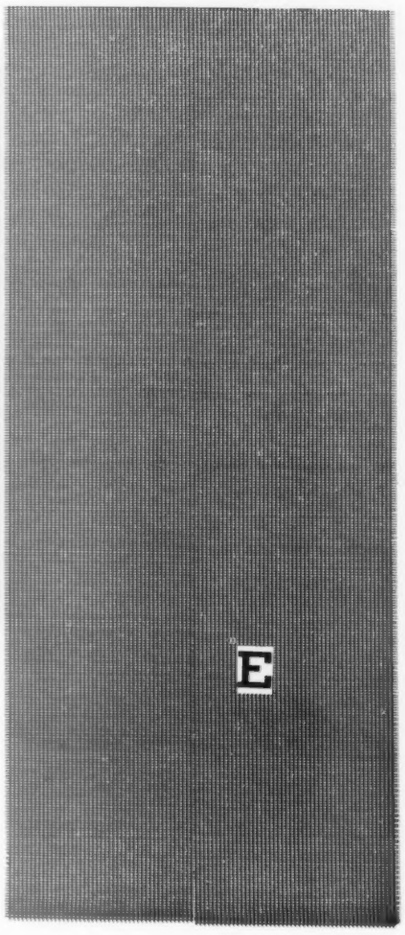


E

Welds in 60-Mesh Wire Cloth.
(4/5 actual size. Current input, 16 watts at 60 cycles.)
D. Horizontal wires butt-welded together in zig-zag manner. (See photomicrograph A on next page.)
E. The welds in this mesh are the same size as the wires themselves, and hence are barely perceptible. About ½ in. of the seam is left unwelded at the bottom to show that the wires are cut straight and not specially prepared. (See photomicrograph C on next page.)

"What thickness is this, about 28 gauge?" I queried. "No, it is thinner than that," he replied, "about—But why guess? Let's measure," wherewith he applied micrometers, showing a thickness of 30 gauge.

Other samples followed from his desk drawer—thin copper alloy sheets, several samples of wire mesh, and a sample piece of 18-8 stainless sheet.

Finally he showed me a weld made in an exceedingly thin piece of steel strip. In reply to my question regarding the thinness of this sheet, he said it was supposed to be 1/1000 of an inch. "But, why take my word for it? Let's measure it," he said. A quick manipulation of the micrometers gave a reading of 0.0012 in.

Seams Can Be Lapped as Well as Butted

This thin piece was the only specimen showed me of the lap welded type. Where the two thin metals overlapped one could detect by close observation five small surface blemishes that resembled tiny pin pricks. They were spot welds made by the same process, each representing a current flow of only one-tenth of a cycle, using 60 cycle power. To time a weld for one six-hundredths of a second is indeed an accomplishment!

The size of the spots? Close to 1/1000 of an inch in diameter or about the thickness of the sheet itself. Another specimen made with this sheet was butt welded.

What about the composition and properties of welds made by this process? These are but slightly different from those of the parent metal itself, Doctor Longoria assured me.

Speed of Welding, Up to 64 Ft. per Minute

But what are the advantages of this process on those applications where other methods of welding are being used? The answer to this question lies at least in part in the low heat input of this new process and its high speed. As an indication of speeds that can be attained, Doctor Longoria mentioned the welding of 16-gauge galvanized steel sheet. The weld was made at the rate of 64 ft. per minute, or more than one foot per second. The electric power for making this weld was 2,286 watts, or but a small fraction of that which would be required by either the electric-resistance or electric-arc method of welding, owing to the very small heat input into the parent metal. The fact that the heat input is exceedingly small is

Photomicrographs of Butt Welds in Wire Cloth and Solid Sheet.

The mesh shown has 60 wires to the inch. Vertical wires (not welded) are brass, 0.00986 in. in diameter. All horizontal wires are welded, these being alternately one of bronze, two of copper, one of bronze, two of copper, etc., each 0.00775 in. in diameter.

Approximate speed of welds in mesh and sheet, 44 ft. per minute.

A. Eight rounded welds, made in zig-zag fashion. Welds produced by simple method of pressing the ends of both wires together at the instant the weld takes place, resulting in a weld about 80% greater in diameter than the wires themselves. No material of any nature is added to the weld. Each weld required 16 watts input to the welder, and 1/420 of a second of time. Magnification, 20 times. (See photograph D on preceding page.)

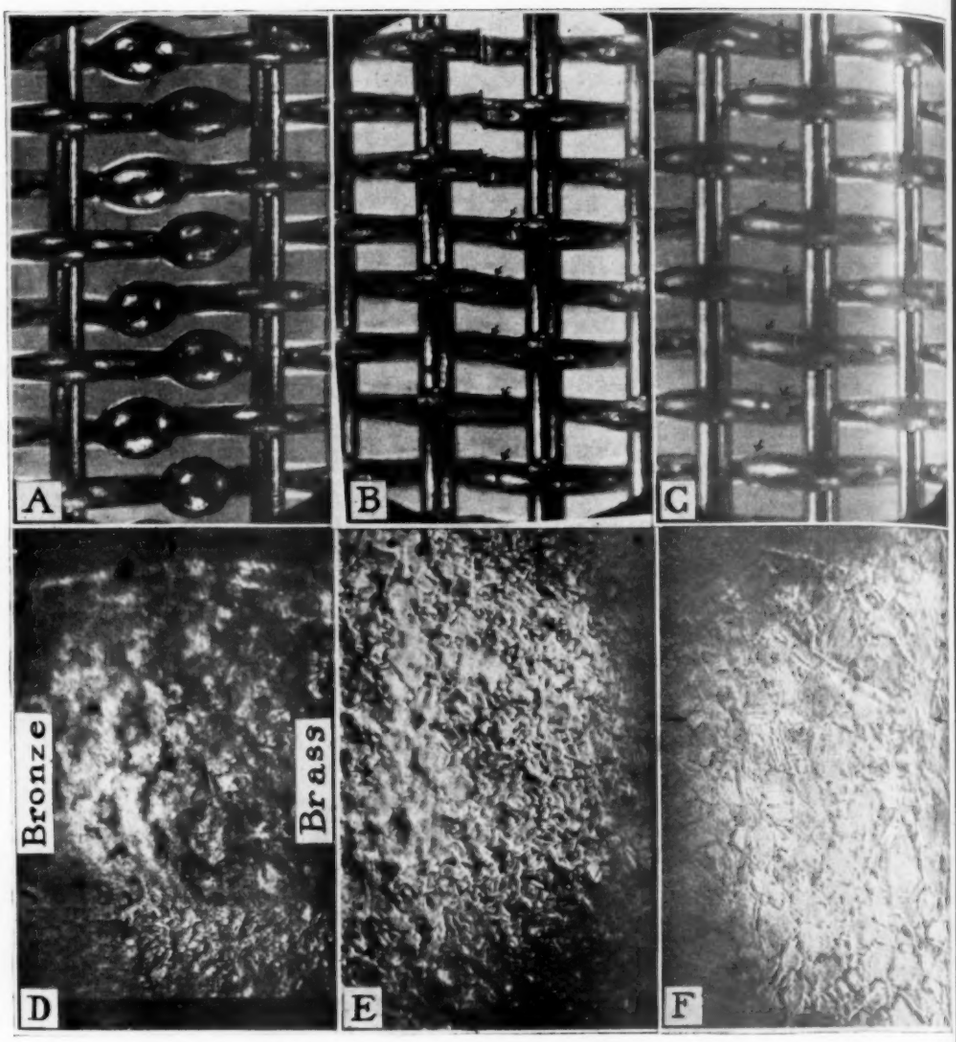
B. The welds in this mesh are practically invisible. Made by another method than those in A, they are the same size as the wires themselves. Five wires are welded, while three wires are not welded nor properly aligned. The input was 16 watts, with 1/610th part of a second required for each weld. Magnification, 20 times. Welds indicated by arrows.

C. Same as B, except that all eight wires are welded. The welds, being the same size as the wires, cannot be detected if one looks at the light through the mesh. Magnification, 20 times. (See photograph E on preceding page.)

D. View of edge of weld between bronze and brass strips, each 0.008 in. thick. Weld has been etched. Magnification, 625 times, then reduced one-half in reproduction. Arrows show approximate location of weld, the exact line of which could not be distinguished because the yellow of the brass mixed evenly with the color of the copper.

E. Same as D, except that the weld is shown flat. Weld has been washed and acid-etched, but not rolled. Magnification, 625 times, then reduced one-half in reproduction. Arrows show approximate line of weld.

F. Crosswise view of weld in two sheets of commercial bronze, each 0.010 in. in thickness. The weld has been rolled three times, then washed and acid-etched. Magnification, 625 times, then reduced one-half in reproduction. Input to welder, 192 watts. Arrows show approximate line of weld.



well revealed by an examination of the 1/1000-in.-thick specimen mentioned above, which showed no signs of distortion at the welds.

Stainless and Duralumin Welds Show Good Characteristics

In view of the low heat and speed of the process, I inquired whether any commercial 18-8 stainless steel specimens so welded had been tested for corrosion. Doctor Longoria replied that a long-time salt spray test had shown no evidence of corrision of the weld metal or the adjacent parent metal.

"Have you made any welds in duralumin sheet?" I inquired, thinking that this process might offer a solution to the problem of duralumin welding. "Yes, here is the first duralumin specimen I made," and out of another drawer Doctor Longoria produced a small specimen, perhaps 2 x 3 in. in size, butt welded. In the few tensile specimens that have been pulled of this material, the weld showed no appreciable falling off in strength compared to the parent metal, said Doctor Longoria.

It was not my host's idea that I should accept these results as conclusive, but no doubt before very long more extensive tests will be conducted in various laboratories as this process comes into wide commercial application.

In trying to picture the practical application of this new welding process, naturally I was interested in knowing just how closely the edges have to abut. The answer given by Doctor Longoria was that the butted edges must fit close together, but that once the weld is started it will bridge gaps that are very small but large enough for the insertion of a sheet of letter paper.

Edges Carefully Butted Before Welding

All specimens of thin metal had been cropped by shears to form the abutting edges in preparation for welding. The process has been used on one specimen of plate ¼ of an inch thick, but that particular specimen was sawed to obtain close fitting edges.

Doctor Longoria's pride in his laboratory instruments was shown frequently during the interview as he mentioned some specific instrument and asked me to see it. A high-powered microscope, the first to be built by which a piece of metal can be examined without lights and shadows, which idea is based on one of his original conceptions—a spectroscope which measures light waves directly in Angstrom units—an x-ray machine—a tensile-testing machine which measures the point of break with an accuracy of 2 tenths of one per cent—in these instruments he takes particular pride. In fact, the eastern firm that built the microscope for him borrowed it to show as a part of their exhibit at A Century of Progress.

There is no secret to Doctor Longoria's success. It is based on the common-sense attitude that, in any research or investigation, good instruments are worth whatever their cost may be. He buys only the very best and frequently these are made to his special order. If the instrument is the best, and your results don't check, then you know that the fault does not lie in the instrument but in you, is the way Doctor Longoria puts it.

Other things of interest to a scientific world came out from those desk drawers and from under his desk pad. But about these I can't talk. However, some day the world will hear more from this obscure laboratory.

Lining Up the Floor Pipes.
(There are 494 such pipes, each connected to a take-off nipple welded to the feed mains.)

Welding Nipples to Feed Mains.
(All welding and bending of pipes was completed in advance of the concrete foundations.)

Pipe for Denver's Ice Rink Has 2,700 Welds

By FRANK CONLY

Seventeen hundred welds went into the installation of the floor pipe for Mammoth Garden, Denver's new ice hockey and skating rink and, under test, not a single leak showed up in the approximately eight miles of piping.

Ray G. Montgomery supervised the work for the Stearns-Roger Manufacturing Co., of Denver, and he breathed a sigh of relief when the big job proved up 100%.

There were an additional 1,000 welds in the ammonia and brine system, and here only three tiny pin-holes were revealed under test—all, fortunately, easily accessible.

All ammonia lines in the compressor room were welded, as far as possible, thus reducing screwed fittings to the practical minimum. Thirty thousand cubic feet of acetylene and oxygen was used on the job.

The floor installation consists of 494 pipes of 1¼-in. standard, full-weight pipe, average length of coils being 82 ft. 11 in. Each coil loops out from a feed header and into a return. The feed and return mains are of 8-in. pipe, reducing through 7-in. and 6-in. to 4-in. at the dead ends. All return bends were made on the job with a power bender, on 4½-in. centers. Three-quarter-inch nipples were welded into the 8-in. feed and return mains on the job, on 9-in. centers, staggered so that the floor pipes would line up on 4½-in. centers.

All welding and bending was completed in advance of the concrete foundations, but when that was done the 246 coils were laid between 8 a. m. and 10 p. m. of the same day. There was some cutting to meet unavoidable variations; 494 pipes had to be lined up with the slots going through the concrete wall of the brine main tunnel; 750 valves, including purge valves, had to be connected up, so that any single coil may be isolated if necessary. But everything went smoothly. The level row of pipes made as pretty a picture as any engineer might take pleasure in looking at, before the last slab was poured and neatly overlaid with terrazzo.

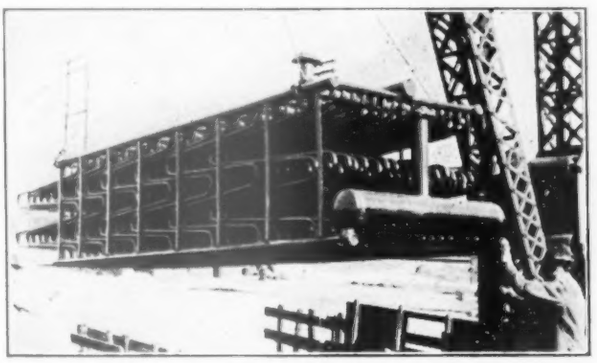
One hundred forty tons of refrigeration is furnished by two 9x9-in. Frick machines, one with capacity control from 100% down to 50% to meet varying conditions.

The brine is circulated by means of two centrifugal brine pumps, one of 750 and the other of 400 gallons per minute capacity.

With both refrigeration machines working at capacity, it required about twelve hours for the initial freeze down of the concrete floor before spraying on the water, but as soon as the floor was thoroughly chilled, it was found that one machine could carry the load, except when there is an extra-large crowd on the ice.

Though the pipe work was well forward all along, the necessary dovetailing with other work made for a grand rush towards the end, but when the scheduled opening arrived—a gala event—there was a beautiful sheet of ice, 80x185 ft., ready for the hockey teams.

A Perfect Sheet of Ice.
(Periodically during hockey games the surface is smoothed, scrapings being put in a pit connected with the sewer.)



15,000 Lb. of Welded Coil.
(The verti-flow coil cools the brine that freezes the ice in the rink.)

Standard Oil Orders Four Welded Tank Barges

The Standard Oil Co. of New Jersey has placed an order with the Marietta Manufacturing Co., Point Pleasant, W. Va., for four all-welded steel tank barges for the movement of petroleum products. Preliminary mention of the inquiry was made in a recent issue of *The Welding Engineer.*

These barges will be 175 ft. long, 35 ft. wide and 8.6 ft. deep, with a capacity of approximately 7,000 barrels. About 800 tons of steel plates and shapes will be required.

The Marietta Manufacturing Co. now has contracts for eighteen pieces of floating equipment, including tank and coal barges.

S. D. Archbald, in charge of river transportation for the Standard Oil Co., has moved his offices from Parkersburg, W. Va., to Pittsburgh and it is believed the company will now enlarge its transportation services on inland waterways.

Use the Emery Wheel Test for your Unlabeled Welding Rods . . .

By J. B. AMES

THERE'S no need to guess whether a rod is high or low carbon, stainless, manganese steel, or some other alloy. Ofttimes a spark test will reveal the information you want, and simple physical tests of the deposited bead can be used to determine the suitability of the rod for the work at hand. The author suggests that rod manufacturers adopt uniform standard markings and stamp them on the rods.

A FEW years ago a welder did not have many rods to choose from. So it was easy for him to know the few different rods and their places. Today the picture has changed to rosy pink, green, lavender and the rest of the rainbow's hue. With the great progress in welding many new rods have been developed and many are in course of development.

Many present-day rods show superior qualities of strength and toughness, and the protective coatings shield the molten metal through the electric arc, leaving a slag coating on the deposited bead, which insures a dense, fine-grain weld metal.

A few years ago the makers of rods were few; today there are many. Each maker can furnish almost any rod asked for. Hence he has a color scheme, a numbering system, and an alphabetical order to distinguish his rods from the rest of the world's goods.

Unlabeled Rods Are a Mystery to the Welder

There is no semblance of standardizing. What about the welder? What about the young fellow coming up? What do they think about all this hidden mystery? (For that's really what it is when you walk into a strange place and see about twenty-five different rods without shipping tags.)

Our plant has a rack of rods minus the shipping tags. In this agglomeration are different cast-iron rods of various colors, some with the added number or letter, and about ten hard-surfacing rods of the variety kind, not to mention the mild-steel and the stainless-steel group. And here we have only a few of the marketed rods. It would be interesting to know how many thousand different rods there are. Yet if these rods were thrown into an indexing machine, many would find the same pigeon-hole.

It is very natural and proper for each maker to resort to his own method of identification. There are a few rods, however, that are marked for the welder's benefit, mostly the bronzes. Of course, they are the bare and the longer lengths. The welder is not interested much in the patented serial numbers stamped on some rods, but Genuine Tobin 1 Mn (Manganese) tells a story.

The writer realizes the problem manufacturers are up against. They are striving for better and cheaper rods. However, when they have a proven Class One electrode, it would be convenient for the welder if they would mark the bare end "Class One." Perhaps a code could be worked out in a simple numerical order to classify all rods for their specific purpose and need. Then if a welder had a red, a white, and a blue rod, all from different makers but marked "Class One," he would know that he was making a first-class weld from the standpoint of electrodes. Should he use a red, a white, and a blue rod marked "Class Eight" (if Class Eight should happen to designate 18-8 stainless steel) then again the welder would know that he was working with safety, instead of doubting.

Some people might say: "It's a poor system if they can't keep track of their rods." But what are you going to do if several boxes of rods are shipped in from some other plant, packed in a hurry, possibly by some clerk who was a good mixer? They must be sorted.

At present the welder who is not content at guessing must resort to some kind of shop analysis, which is not the easiest thing in the world. The spark test is one the welder should become familiar with. A cold, black piece of iron or rod does not tell much, but a spark from that iron or rod is not cold and black. It carries a hot message, informative to those who study it. The more one uses the spark test the more one will depend on it.

Emery Wheel Sparks Tell the Story of a Rod's Metal

Those who have touched a file to an emery wheel have seen carbon sparks in abundance—a bushy mass of sparkling beauty. They are short-lived, due no doubt to the oxygen of the air absorbing them very quickly. Iron almost carbon-free has an entirely different spark—straight, yellowish streaks with little spread, and they travel farther than the carbon sparks. A file has about 1.10% carbon, and most welding rods from about 0.03% to 0.20% carbon. With a little practice a welder can spot the carbon content in rods or in his steel close enough to avoid trouble.

At this point it might be well to state that a 0.03%-carbon rod laid down on a 1.10%-carbon file will produce another effect. The spark from the bead will be unlike that from the file or the rod itself. It is an interesting experiment.

Cast-iron rods are a tough lot to deal with, some being almost pure iron (with carbon, of course), and others having a very high nickel content. To confuse things, some such rods show many carbon sparks. Between the two extremes of pure iron and high nickel content there fall many rods, some with different elements added to them. Most all cast-iron rods have a sound and action different from mild-steel rods when welding. They seem to "pluck-pluck" away, whereas the steel rods have the faster purring sound.

Electrodes used for boilers, tanks, structural steel, etc., all have very nearly the same mixture of carbon sparks. Stainless-steel rods are rather easy to pick out. The chromium and nickel sparks are dark cherry. They are lazy and travel but several inches from the wheel; they let the iron sparks do all the shooting. High chrome-nickel rods show little or none of the iron sparks, but with a little pressure against the emery wheel the friction heats the tip of the rod to a dull red in several

seconds, the metal dragging and leaving a ragged burr. One thing to note about high chrome-nickel, heat-resisting alloys is that the spark does not follow around the wheel.

Monel rods (copper and nickel) have a sluggish, dark-cherry spark. With a little pressure against the wheel the metal carries over and leaves a ragged disc. The thin disc section will show a distinct copper collar.

Hard-surfacing rods show many different sparks and colors. It seems as though every maker of hard rods had his sparks copyrighted. Of course, anyone can tell a high-carbon rod, but few rods show the sparks of a high-carbon drill. They contain less carbon (or at least show fewer carbon sparks) and more of something else, until we finally reach the high speed variety, containing chromium, tungsten, vanadium, molybdenum, cobalt—perhaps there are more, but why make things too hard?

High-Speed Steel Has Sparks Like Chrome-Nickel Steel

High-speed-steel sparks resemble the chrome-nickel spark somewhat, one important difference being that the high-speed sparks fly around on the surface of the emery wheel. The chrome-nickel sparks play a different game; although they load the wheel, they work in the dark.

The manganese spark breaks company very abruptly. He shoots off at right angles from the crowd, spreads all his branches with an explosive brilliance and disappears as suddenly. Hard-surfacing rods have a firm feel on the wheel, and leave a clean cut. Whenever there is doubt about a hard rod, run a short bead and use a file. The file test is a handy one.

Recently the writer's attention was called to a broken weld on a stop block used on a conveyor. The block was of cold-rolled steel (about 0.12% carbon) and a nice heavy, even bead had been laid down. Why did it break? One touch at the emery wheel told the story; the weld was made from hard-surfacing rod.

It's bad and doubly expensive to use the wrong rod. They used to say, "A weld is no better than the man who makes it." Now they say, "A weld is as good as the rod you use." Where is the man to choose the rod?

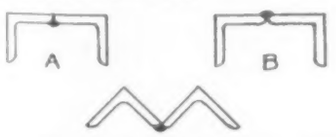


Fig. 1 (Top), Fig. 2 (Bottom). Simple Method of Testing Weld Bead.

If you have some rods you do not feel sure about, use the angle-iron test. Cut off several pieces of angle iron ¼x2x2 in., and about 3 or 4 in. long. Weld as shown in Fig. 1, with two angles, forming a channel. After the coupons have cooled, take a 3-lb. hammer, bridge the test piece (with inside weld) on an anvil and strike, strike, strike! The weld should hold until the coupon looks like Fig. 2. If it does not, try another rod.

The other test piece (with outside weld) throws all the burden on the weld metal. Strike lightly and see how much you can bend the weld metal before it breaks. If it tears along the line of fusion, it's good. If it lets loose quite easily, look out. This test will almost always show up the wrong rod in the wrong place.

But let us not neglect our stumbling blocks in cast iron. Some welders say they can weld cast iron with the metallic arc quite easily. Interesting, but no doubt they have made quite a study of the different plain cast irons and the many graduations in cast-iron alloys.

Cast iron is made for its specific purpose. Foundries pour many different brands of cast iron. White castings are very hard and brittle. The carbon, about 2.50% to 3.75%, is combined—fixed, as it were. The foundryman wants it that way.

Gray castings are much softer and stronger. Although their carbon content is about the same as in the white casting, the foundryman has added a little more silicon to free the carbon in the form of graphite flakes. In this manner the foundryman can control his fixed and free carbon. The better grade of castings are harder and very much stronger. They are spiced with nickel, nickel-chromium, nickel-chromium-molybdenum in varying degrees, until the high nickel-chromium heat-resisting castings are reached.

Much is to be done in the cast-iron field, and the welder who can figure out his castings is the fellow who will collect.

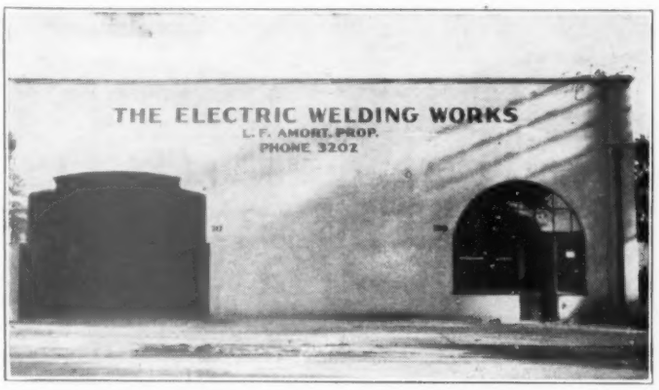
Many welders are not confronted with these problems about rods and cast iron. They are the fortunate ones, or perhaps they are unfortunate. They are riding high today, but tomorrow they may have to choose and select rods for themselves.

It is gratifying to note that several makers of rods are tagging their bundles with operating instructions, such as purpose of rod, straight or reversed polarity, current requirements on different thicknesses of metals, tensile strength, etc.

The day is coming when the welder will want to know what's what, in and about the rod. He will look forward to education in the bundle.

California Shop Owner Has Attractive Building

There are not many good-looking welding shops, and when one comes across as fine an appearing shop as the one shown in the illustration, it arouses one's admiration. This is The Electric Welding Works, at 217-19 W. Montecito St., Santa Barbara, Calif., which business was founded by Leo F. Amort in 1920, after his discharge from the U. S. Army. At that time there was no welding shop in the 400 miles between Los Angeles and San Jose. After working up a good business, Mr. Amort has now acquired a ranch, and is looking forward to the time when he can devote his entire time to ranching and leave the welding business to someone else.



A Really Good Looking Welding Shop.

Yet the owner intends to give all his time to ranching!

Welding Helps to Harvest Bumper Soy-Bean Crop

Equipping combines for pneumatic tires made a nice sideline for the welding shop of Huffman Bros. & Gavin, Bluffton, Ind., during the winter just passed. The soy-bean crop was very heavy this season, and the unseasonable weather made it difficult for the combines to harvest the crop, except those equipped with pneumatic tires.

Up to the middle of January, the Bluffton shop had reconditioned nine combines by cutting off the old steel rims and centering and welding on drop center rims. Also the breakage in the field, aggravated by bad weather, made extra business for the shop's portable arc welder. Fred G. Huffman, one member of the firm, was called out of bed one night to go out into the country several miles to weld a frame on a combine that broke while being operated by the night shift.

Resistance Welding—III

Theory and Application . .

(Third of a series of articles)

By L. H. FROST

Welding Engineer, The Electric Controller & Mfg. Co.

(For Figs. 1 to 6, see *The Welding Engineer*, Jan., 1936.)

IN ADDITION to spot welding (discussed in the previous two articles of this series), resistance welding is also applied in a form known as butt welding. In general, this is performed either by straight butt welding or by flash butt welding. In straight butt welding, the two pieces to be welded are butted (see Fig. 9) with sufficient pressure to forge the pieces together, after they have been brought up to welding temperature by the passage of current. This is essentially the same as the method of Fig. 1. It is evident that the surfaces must be smooth and in intimate contact to secure a perfect weld. In general, longer time of current application is required than for spot welding in order to sufficiently heat the entire area to permit upsetting. Upsetting is usually required to insure penetration of the weld and as a natural corollary of forging pressure.

Flash Welding Generally Employed for Large Sections

Because of the necessity of carefully preparing the surfaces, and the larger current values required by straight butt welding, this method is generally not used where large sections are involved, but flash butt welding, or flash welding as it is commonly called, is generally resorted to. In this method the pieces to be welded are clamped in the machine with the surfaces lightly touching. Current is then applied and the pieces slowly moved together. As the surfaces make contact, the metal is burned away in a continuous flash of molten metal. This burning or flashing prepares the surfaces to permit intimate contact, and also leaves them molten for forging. After sufficient flashing has occurred to prepare the surfaces, the pieces are

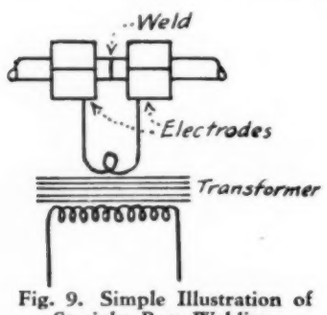
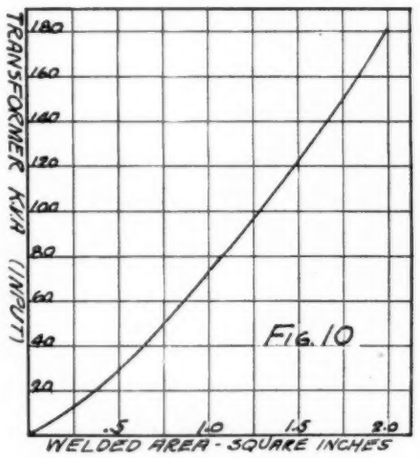


Fig. 9. Simple Illustration of Straight Butt Welding.



forced together rapidly, and forging and upset take place. Fig. 10 gives the transformer input, in kva., and the time required to weld mild steel by the flash butt-welding process.

A comparison of Fig. 10 with Fig. 4 shows that the time required for flash welding is much longer than for spot welding. This is due to the longer time required for the flash, at the same time keeping the required transformer capacity as small as possible consistent with reasonable production rates. Butt welding without flash will require transformer capacities comparable with spot welding if the weld is to be accomplished in the same time, but in general longer welding periods are used in order to decrease transformer capacity required. The production rate (welds per hour) is usually much less for butt welders than for spot welders owing to the longer time required to place work in and remove it from the butt welder, and therefore the longer welding periods do not appreciably affect the production output.

Projection Welding Suitable for Many Kinds of Work

It is not difficult to determine which jobs are definitely spot-welding jobs and which butt-welding, but there are a number of jobs which are hard to classify, though they are definitely resistance-welding jobs. Many such jobs may be done by a method known as projection, embossment or relief welding.

In projection welding, a number of spot welds are made at one time, and a round, punched projection or embossment is used to locate each spot. Machines are in use making as many as 21 of these welds at one operation. In addition to increasing production on those jobs which can stand the die expense for embossing, the projection weld has application for those jobs requiring welds of a peculiar shape or arrangement.

Fig. 11 is an example of projection welding in which the joint is required to be liquid-tight in addition to having the necessary strength. This is accomplished by making the projection in the form of a ring, which provides the necessary tightness as well as strength after the weld is made.

Determining Proper Dimensions of Projections

The height of the projection is determined by the thickness of the pieces being welded, and the nature of the work. For clean, mild steel in smooth stock, excellent results may be obtained with the shape shown in *A*, Fig. 12, although many designers use the shape shown in *B*. Up to 18 gauge, a projection similar to *A* need be only 0.010 in. high, but care should be taken to see that this is accurate, as a few thousandths variation is important, especially if many projections are used. For heavy stock, such as 12 and 10 gauge and heavier, the shape as shown in *B* is used, these being from 0.030 to 0.045 in. high.

The diameter of the projection depends upon the thickness of the material, and the number of spots is determined by the strength required. On 20 or 18 gauge, a 3/16-in.-diameter weld may be figured as having an ultimate strength of 250 lb. in tension or shear (not torsion or twisting), used either singly or in groups. This value does not allow any factor of safety and presupposes

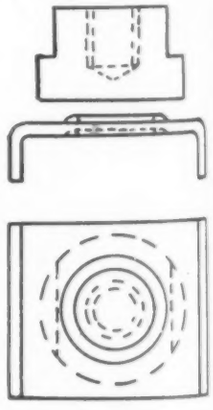


Fig. 11. Special Type of Projection Weld.

(The ring-shaped projection makes a water-tight weld and gives high strength.)

that every weld will be a uniform, perfect weld. Thus if a certain part required a strength of 250 lb., it would be advisable to figure on at least two welds —and better yet, three—to allow for variation in welding and to have a factor of safety. If a strength of only 75 lb. is required, then one weld should be sufficient. In most machine designs it it not always possible to calculate what the maximum possible load will be, in which case it is advisable to use a greater factor of safety as determined by other parts of the design.

To determine the transformer capacity required, a simple rule based on trial and error is 50 kva. per spot up to 16 gauge. Projection welding requires the

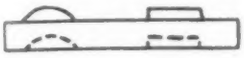


Fig. 12. Projections May Assume Various Shapes.

same kva. per spot as spot welding, so the curves in Fig. 4 may be used to determine transformer input. For a large number of spots, transformers of large capacity are required.

The pressures required for projection welding are more in line with those for butt welding than for spot welding, though in general the data in Fig. 5 can be applied. Sufficient pressure must be supplied for upset after welding, as well as to force the surfaces in contact. The pressure must be determined by the height and size of the projection as well as current and time. However, a method is now coming into prominence in which a low pressure is used for welding and a heavy pressure used for upset and forging. From Fig. 3 and Fig. 6, it will be seen that this forms an excellent arrangement, and in many cases it has been possible to obtain excellent welds at values of only one-fourth of the trial-and-error rating mentioned above. These are known as dual-pressure welders, and are now commonly supplied in air or hydraulically operated machines although this method has been used to some extent on mechanically operated machines.

Flat Electrodes Generally Employed

Projection-welding electrodes generally have flat copper surfaces which contact much larger areas than do spot-welding electrodes. Since the current is distributed over large areas, the deterioration of the electrodes is not as great as for spot welds, but the electrodes are more costly. In most plants having high production, the use of hard copper alloys as electrode material has been found profitable. These hard alloys of copper approach the preferred form mentioned earlier. The best known of these are Elkaloy, a copper-tungsten alloy, and Mallory No. 3, a nearly pure copper alloy which obtains its hardness from heat-treating and cold-working and retains its high electrical conductivity.

By the use of projection welding, it is possible not only to increase production in some cases, but also to perform some jobs that would be impracticable for spot welding, such as work requiring special and unwieldy jigs for alignment of pieces prior to spot welding. In many jobs, the use of projections eliminates these jigs.

Hollywood Actor Uses Welding Outfit in His Home

Wallace Beery has added a welding set to his shop equipment. The shop, which contains cubby-holes for fishing paraphernalia, guns, airplane models, cameras and other nick-nacks, was built when Mrs. Rita Beery revolted at overflowing closets.

The welding outfit is Beery's pride and joy. Beery says it is amazing how many things he has found to weld around the house.

"Would you believe it," asked Beery, "I just leaned a little bit on my iron grill gate to test it—and it broke at the hinges?"

But Beery claims the gate is now as good as new—and a very swell job of amateur welding.

"Why," said Beery, "I've practically welded that house together since I got my outfit!"—*Sunday Times (Chicago).*

Welding Unit Is Useful for Starting Cold Engines

Weak batteries in cold weather often result in failure to start the automobile. It is then that a d.c. welding outfit may come in handy. The terminals of the welding generator are connected to the automobile battery, positive to positive and negative to negative, and the voltage brought up slowly, after a good connection has been made. This gives more power for starting the engine than one could possibly get from any battery, says C. J. Holslag, chief engineer, Electric Arc Cutting & Welding Co., Newark, N. J.

Once the engine starts, the battery will pick up. There is no danger, if a good connection is made to the battery, says Mr. Holslag. The voltage of the welding set will stay the same as the voltage of the battery, no matter how many amperes are put into the starter circuit.

In a similar manner, a battery of gas-engine-driven welders can be started in cold weather, after one welding set is running, by connecting positive to positive and negative to negative, in which case the generator on the second machine will act as a motor and run the gas engine until it takes hold, points out Mr. Holslag. On certain differential sets, polarity is liable to reverse, but after it is built up one can reverse it back again very easily by lifting the brushes and applying positive to positive and negative to negative. Of course, one must take reasonable care that this practice is not overdone, with resulting overheating of the first machine.

Arizona Welder Holds Barn Dance in Shop

By LUCIUS S. FLINT

A welding shop makes an excellent place for an old-fashioned barn dance. R. A. Emmett, head of the Maricopa Machine & Welding Works, Phoenix, Ariz., recognized that fact and recently took advantage of it to get acquainted with a lot of new people and stimulate good will among his old customers.

He engaged several musicians, bought a keg of beer, and invited the public to attend an open house. During the evening a large number of people came in, some only for a short time and others to spend the entire evening. Emmett was personally on hand to greet the visitors and see that they had a good time.

The novelty of the whole affair was what made it "click." People enjoyed the unusual experience of dancing around welding outfits and heavy machines. The fact that they had to dance on a cement floor and that the orchestra was a bit "primitive" didn't bother them in the least. Out of curiosity, a lot of passers-by dropped in, and a lot of other people parked their cars and stopped long enough to see what was going on. Of course, the company's name and location were impressed on them.

Starting with nothing, in the worst of the depression period, Emmett has built up one of the best welding businesses in the state, and he traces most of his present volume to good-will building. He hasn't spent a lot of money for advertising and he hasn't solicited business. But, he has made it a point to do good work and make a personal friend of every customer.

"As I see it," says Emmett, "one of the biggest mistakes a new shop can make is to try to expand too fast. Unless you have the capital and equipment to handle a large volume, there's no use trying to get it. I started out with very little capital and equipment and built up slowly. If I wasn't in a position to do a first-class job, I told the customer so—and gained his good will. Gradually, I improved until now I have an absolutely complete shop—and the new customers have come along gradually as I grew."

Welding

on display at the

Chemical Show—II

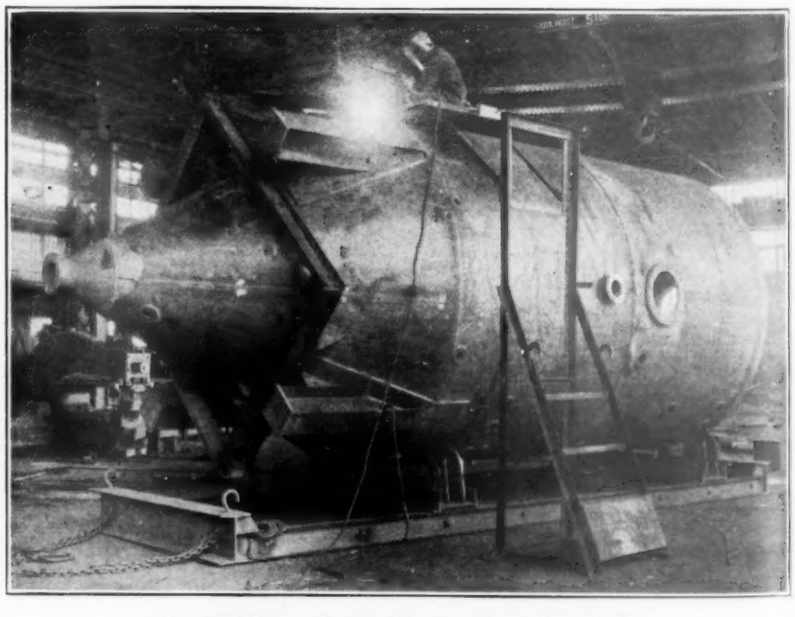
(Second of Two Articles)

By ORN T. WEIRS

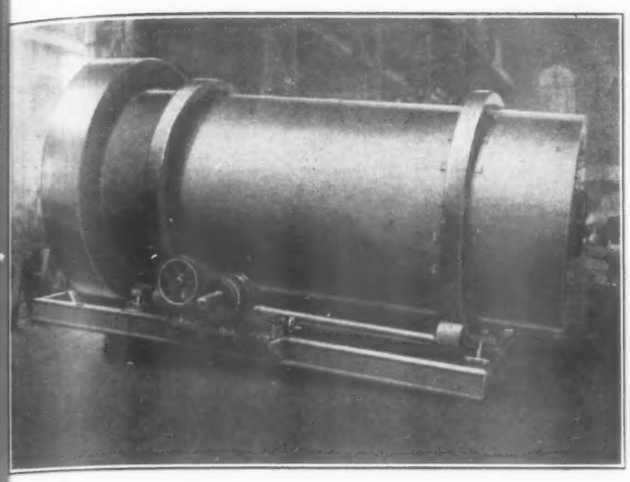
AIR-CONDITIONING installations recall to mind a profitable application of welding which certainly should not have been conspicuous by its absence of representation at the Chemical Exposition—namely, welded piping, which is being so increasingly favored by vigilant industrial engineers everywhere. In speaking of this lack of representation, reference is to the several important companies who make the special pipes and fittings required, and not to the manufacturers of welding equipment. For this year's "Chem Show" found the Reduction Sales Co. and the Union Carbide & Carbon Corp. so cognizant of welded piping's immediate possibilities, that both firms featured it with full-page advertisements in their December appeals to the process and food industries. The welded piping business ought to be considered seriously by all journeymen welders, especially in connection with the currently developing interest in air-conditioning, and the preference that is manifesting itself everywhere towards oil burners. The hundreds of miles of welded transmission pipelines all over the country long ago proved welding to be eminently successful for piping applications, as have also the more recent heating and power installations. Certainly welded piping is no longer on trial. Accordingly, in connection with any sales endeavors intended to stimulate this field of welding, its principal advantages, as verified by chemical engineers, deserve recapitulation here. These are:

Twelve Cardinal Reasons for Superiority of Welded Pipe

(1) Savings of from 10% to 20% in the all-inclusive costs of installations, due chiefly to the average reduction in the number of fittings necessary which, in some cases on record, have scaled down to as few as only 5% of what threaded jobs would have required. (2) This means a corresponding reduction in the number of sources of future service troubles. (3) Insulating costs average 5% to 8% less, while the savings on insulating labor have been proved, by actual figures, to amount to as much as 30% less. (4) Pressure losses attributable to friction and turbulence—conditions especially aggravated by the projecting pipe ends in threaded installations—are cut down by 15% to 45% in welded jobs which are perfectly smooth inside throughout the entire lengths of the lines, and which can also be favored with sweeping elbows instead of the short-angle fittings so common in screwed installations. (5) Welded jobs show considerable savings in time and labor, due to the comparative speed and ease with which the work may be done, and because whole sections of installations may be first conveniently fabricated in contractors' shops, and then placed in position on the job and welded together at a relatively small number of remaining joints; the advantages of this for achieving accuracy and freedom from the strains inherent to threaded installations are obvious. (6) Welded joints are stronger than the pipes themselves; welding fittings stand the expansion, contraction and weaving stresses of the lines much better than screwed fittings, which soon leak under the impositions of such strains. (7) Angle fittings, especially reinforced against the usual wear to which such elements are subjected, are available for handling industrial solutions which circulate crystals or other materials of an abrasive nature. (8) Quick deliveries from stock are practically as available today for welded fittings as for the better-known screwed fittings. (9) Welded jobs show a considerable saving in weight, since the wall thicknesses of pipes which require no threading are reduced by from 25% to 40%; in an average, medium-sized building, the saving in weight from this one source alone has been reported as amounting to as much as seven tons. (10) Welded pipelines can be placed much closer together than is possible with threaded or flanged jobs, and in all sorts of involved situations such as would be impossible otherwise; in fact, there is no intricacy of layout or erection that modern welding fittings do not take care



Arc Welding a Large Vacuum Crystallizer Body.
(Work being done in the shop of the Swenson Evaporator Co., Harvey, Ill.)



Counter-Current Classifier of Welded Construction.

(In the fabrication of these units, the Hardinge Co., York, Pa., abandoned riveted construction in favor of arc welding. This company is also turning to welding for their Ruggles-Coles dryers, which are of somewhat similar appearance, but considerably larger.)

of with comparative ease—obviously one of the most important considerations in designing efficient and economical piping installations. (11) Alterations and additions by means of welding and cutting torches are much more readily and inexpensively made than are the corresponding changes by the usual, cumbersome methods for threaded jobs. (12) Speaking facetiously, if we may, there are many fewer tools and supplies for a welder of piping to leave in the shop and forget to "bring on the job," than is the case with his less-progressive competitors who are continuing with the ancient methods of a decadent era.

Stainless-Columbium Alloy Eliminates Carbide Separation

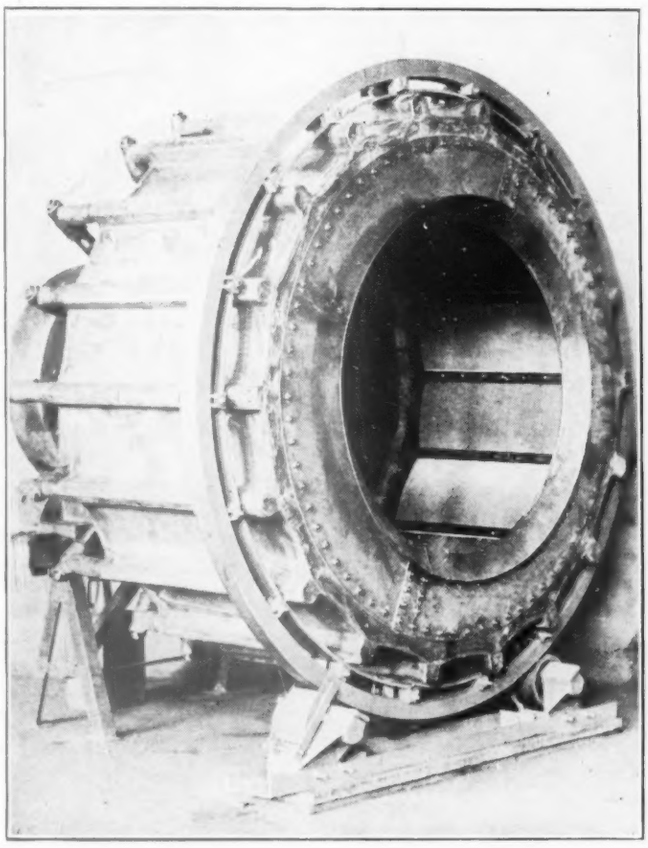
"Time marches on!"—and so does this article. Stuck off in one corner of the Union Carbide & Carbon exhibit, like a shy little violet, was a noteworthy stainless-steel alloyed with a small percentage of columbium. We wonder how many builders of stainless-steel apparatus saw this—especially those interested in the applications among the food industries. Some alloy of this sort seems to be absolutely necessary for stainless-steels which have to be heated in chemical manufacturing processes, prior to immersions in acids; but undoubtedly of more interest to welding engineers is the claim that this material welds with greater facility than the ordinary 18-8 stainless-steels, besides also without any evidence of the usual porosity or burned areas adjacent to the welds. It is this "burning" problem with straight 18-8 stainless-steels that has been so troublesome to the fabricators of welded processing equipment, especially for the food industries in connection with sanitary considerations; so that several such firms are reported as having resorted to sending all such work outside their own plants to specialists in the stainless-welding field.

This brings our remarks to a mentioning of what several manufacturers consider as an opportunity for a limited number of rather affluent individuals to cultivate into a sturdy limb on the industrial tree. They have in mind the development of a few large concerns specializing in nothing but intricately welded details of equipment requiring unusual facilities or care in construction. The idea advanced is to scale such set-ups to national rather than to local or even territorial requirements, so that the attendant charges might be favorably comparable with conditions existing in the other older and much more widely utilized manufacturing services. Certainly a number of welding companies are inclining somewhat in this direction; but what is said to be noticed as definitely needed is a set-up arranged especially to serve the average manufacturer in somewhat the same manner as the drop-forgers now serve the automobile industry. It was generally admitted, of course, that this would require an expensive and persistent advertising campaign, before the advantages to be gained were securely, or at least satisfactorily, established in the engineering profession's skeptical consciousness.

Savings Effected by Welding Shapes for Machine Frames

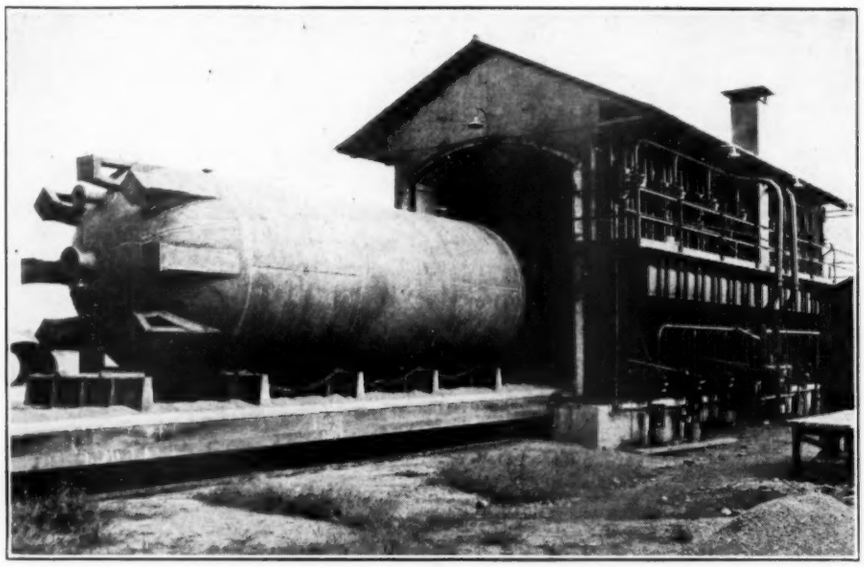
One of the commendable trends, more in evidence this year than heretofore, is the tendency towards welded machine frames built up out of ordinary structural shapes, instead of being riveted or cast (as in Don Quixote's time). Most of this work is being done by the electric arc. Savings are reported in every case, because expensive machining and pattern making are obviated, pattern storage is eliminated, and the requirements of "tailor-made" jobs are turned out not only much quicker, but also better.

For instance, in connection with a very generally popular class of vulcanizers and similarly designed pressure vessels, welded-on head rings of rolled steel are now applied almost universally in place of the formerly used heavy castings that were always a source of trouble, due to their porosity. As one among several firms interested in this class of business, the Buffalo Foundry & Machine Co. changed to welding five years ago. They have found that this improvement in fabrication methods has been not only profitable, but markedly



Continuous-Type Filter for Chemical Plants.

(This Dorrco filter, 6 ft. in diameter with a 3-ft. face, is made of Everdur, welded, and was designed by The Dorr Co., Inc., 241 Park Ave., New York City, and built under their patents by the Oliver-United Filters Co., Oakland, Calif. It is used for removing sodium chloride brine.)



Welded Sulphate Digester Leaving Annealing Oven.
(This vessel, built for a Canadian papermill, by the J. P. Devine Co., Mt., Vernon, Ill., is 9½ ft. in diameter and 33 ft. long.)

advantageous in the building of large apparatus which must pull and efficiently maintain vacuums up to 29 in., and likewise for other equipment which is large in size and which must hold pressures of 100 lb. per sq. in. or more. Also, the superior advantages of welding in making constructions possible that are exceptionally favorable to sanitation considerations is another of their reasons for this preference, especially as concerns the fabrication of apparatus like their evaporators, which are so deservedly approved in the food industries. Commenting upon one style of pilot-plant evaporator with double-drum dryer, such as is used importantly in the determining of accurate indexes for full-scale manufacturing operations, one of this company's engineers pointed out that their welded construction has allowed a reduction in wall thickness to 3/16 in., whereas cast walls for such service were formerly made from ½ to ⅝ in. thick. The door of this evaporator is of dished plate, designed with welded-in observation windows and a welded-on head ring, and featuring a welded-on seal ring of very dependable efficiency in the dairy work for which the machine finds its widest application.

Buflovak also report a recent turning to welding on almost all of their copper tanks and shells, this practice working out to be much more satisfactory than the riveting and brazing used previously. Worthy of special attention is the fact that this same company was leading a trend with their showing of the most complicated, welded machine frame to be seen at the Exposition—the skeleton of one of their Buflovak two-stage, double-drum dryers, having overall dimensions of 6 ft. square by 12 ft. high. This entire frame was built out of standard channels and I-beams, are welded together.

Turn to Welding as Corrosion Preventive and to Cut Costs

In fact, all the builders of the more massive equipments are lining up in favor of welding wherever it can be applied. One of the engineers for the Swenson Evaporator Co., Harvey, Ill., outstanding pioneers in the building of crystallizers, filters and evaporators for use in making milk and beet sugars, kraft pulp, soaps, lye, caustics, glue, viscose rayon and glycerine, said that they were endeavoring to outlaw riveting and resort to welding as much as possible in order to eliminate the corrosion troubles which have been found to concentrate especially at riveted joints. Such well-known materials as electrolytic caustic, pulp-mill black liquor, and corrosive acids are now handled almost exclusively in welded equipment. Like everyone else in the chemical and process fields, the Swenson company reports sizable savings through their recourse to welded instead of riveted and cast constructions. Moreover, their pioneering in this conection has resulted in perfected methods and apparatus which greatly widen the successful use of welding, especially as concerns the progress they have made within the past 10 years in welding nickel, nickel-clad steel, monel metal, 18-8 stainless steel, and even copper. Most of their steel-plate work runs from ½ to ¾ in. in thickness, from 6 to 18 ft. in diameter, and in a variety of heights and lengths up to 40 ft. and more.

Among process and industrial engineers, few if any manufacturers enjoy a better reputation than is the merited good fortune of the Hardinge Co., York, Pa., makers of machinery to grind, classify, thicken, scrub, dry, feed, separate, weigh, wash, clarify, calcine and cool 75 distinctly basic classes of material in 28 different industries. Their apparatus is applied to such widely varied requirements as are presented by different operations in the processing of abrasives, battery plates, cement, coal, copper and gold ores, glass, insecticides, sewage, cosmetics, and tobacco stems—to list but a few. Riveting had always been employed in this company's constructions. Therefore, it is of special interest to note that they have been getting more and more into welded construction for some time now, with very satisfactory results, indeed. This is particularly significant in view of the Hardinge Co.'s firmly established reputation for designing and fabricating equipment possessed of the advantages of very adequate simplicity, unfailing ruggedness, high efficiency, compactness, and negligible repair costs. One of their first experiences with welding on a large scale was in connection with their counter-current classifiers, which are revolving drums mounted on steel tires, something after the fashion of cement kilns. Sizes range from 1½ ft. in diameter by 4 ft. long to 10 ft. in diameter by 28 ft. long, and in weights from ½ to 45 tons. Excepting for the parts which may have to be removed easily, these classifiers are all-welded throughout, including the screw-flights inside, which are not only of varying pitch, but built up from plates of varying sizes as well. The welders responsible for this detail in the smaller units deserve special mention for their ability at working under conditions of necessarily limited and difficult clearances.

This article would lack completeness without mentioning the masterly craftsmanship of the Blaw-Knox Co., the famous "Ductilwelders" of Pittsburgh. No one has ever excelled this firm in welding; and the corollary is that no American can live through a day without coming in contact with a number of products that have been processed by means of their 54 different kinds of welded equipment. In even a stroll through the streets of an average-sized city, one is likely to pass over innumerable frames of their electroforged gratings, such as are also so satisfactorily applied in industrial plants for the flooring of platforms.

Another prominent engineering organization of exceptional welding ability is the J. P. Devine Co., of Mt. Vernon, Ill. Most of their fabrication is of the "tailor-made to order" variety. Some idea of their facilities can be visualized from the fact that their shops are tooled to handle 2-in. thick steel sheets up to 20 ft. wide, and lesser widths up to 3 in. in thickness. They have been building

arc-welded pressure vessels for several years, and are reputed to be exceedingly alert in improving their technique and equipment with every new advancement in the art. Their present facilities include a car-type annealing oven 14 ft. wide by 15 ft. high, and 54 ft. long, in which unfired pressure vessels up to 100 ft. in length can be handled in two heats under uniform temperatures automatically controlled to within plus or minus 15° F. Industrial radiographing is used in examining all their welds, as well as in checking the work of the welders in conjunction with other tests, including periodic qualifying. One of the most interesting of J. P. Devine's fusion-welded, annealed and radiographed jobs is illustrated by an accompanying photograph — a 9½-ft.-diameter by 33-ft.-overall-height sulphate digester, intended for a working pressure of 160 lb. per sq. in. This digester is unusual in that it was designed to meet the requirements of both the Canadian Interprovincial Code by special registration, and the A. S. M. E. Code for Unfired Pressure Vessels. It therefore had to be inspected and qualified by representatives from both the Quebec Department of Labour and the Hartford Steam Boiler Inspection & Insurance Co. Incidentally, this digester was the first welded unfired pressure vessel for steam service to enter the Province of Quebec. Perhaps its most interesting feature of design is its welded 16-segment internal bottom cone for supporting its charge.

Welding Saves Time and Expense In Filter Construction

Continuous filters are probably more widely used in the process industries than any other item of equipment, excepting pumps and electric motors, of course. But filters are mentioned here because of the fact that, within the past few years, all leading makers of such equipment have gone almost exclusively to welded construction wherever there is any possibility at all for its utilization. The principal reasons for having done so are fabrication economies and quicker construction, particularly as concerns the invariable demands for design changes with every sale, so the special requirements of each specific application might be met. Modern continuous filters are expensive hand-made machines, requiring about three months to build, and averaging approximately $15,000 apiece in cost. Filter drums are usually divided into 18 or 24 individual and separately functioning units, each composed of a multitude of intricately welded parts in a construction that must be vacuum-tight and connected by ¾- to 1½-in. pipes into a trunnion face-plate which, in turn, mates with a valve—the delicate heart of the operating cycle of sequences, consisting, first, of a vacuum for "cake" forming, then washing and drying, and finally a shot of air for discharging the "cake." On modern filter installations, welded piping is being used for all the connections between the filters, vacuum pumps and air compressors, and welding is of course used for the construction of the receivers, moisture traps and condensers. This practice first gained favor in the cement industry, where it was found more economical and satisfactory to use 10- and 12-in. spiral welded pipe for the long vacuum lines to the pumps, instead of ordinary flanged piping. Welding is commonly used in filter installations for making up the steel chutes which carry away the discharged filter "cake," as well as for the supporting steel structures under the filters themselves, and also for tying the condensers and traps, weighing from ½ to 1½ tons, into their normally high locations—usually in cradles welded into the roof trusses.

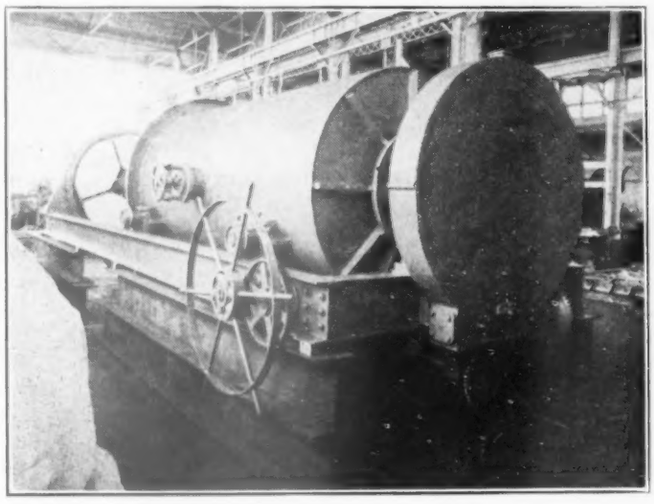
In completing this picture of welding among the chemists, it should be mentioned that two different exhibitors of laboratory furniture were featuring very trim and neat welded steel constructions. Evidently such furniture is popular and has proved its advantages over what most of us remember from our college days, for it is reported that the famous universities and leading industrial establishments are now buying it in truly enormous quantities—55 carloads to one college, 35 to another, 25 and 22 respectively to two outstanding industrial establishments, and so on, here and there. The principal advantage of such furniture is that it is fireproof; and no one will question the fact that welding is the most adequate means for its fabrication.

Laundry Machine Company Uses Special Spot-Welding Fixtures

The American Laundry Machine Co., parent organization of the "Chem Show" exhibitor, the Rochester Engineering & Centrifugal Corp., makes an extensive application of spot-welding to their "Cascade" washers, which are used in groups including as many as 30 for such industrial purposes as washing filter cloths, photographic film, drugs, ink, hosiery and rayon. In some of these applications it is imperative that the washing cylinders be so constructed as entirely to obviate any possibility of scratching or tearing the materials handled. Spot welding has proved to be the cheapest and most practicable fabrication method for accomplishing this purpose. Both of the two mentioned firms use welding wherever feasible—the application in the case of the centrifugals being for the main frames, which are built up out of 8-in. channel iron. The baskets are also welded. The nature of the industrial washer business has caused the laundry machine company to develop special spot-welding fixtures of sufficient adaptability to admit of their being used in the fabrication of almost any sort of washer design, regardless of what special applications might impose.

Material-Handling Equipment Made By Welding

Studies of this sort deserve more attention in modern machine design than is commonly accorded to them, both as concerns industrial plants and our big, modern universities of engineering instruction. Of all the exhibitors at the exposition, the most apparently alert to this appreciation is the Lewis-Shepard Co., builders of material-handling equipment for every industry, and one of the first companies in Boston to use welding extensively in manufacturing. They make lift trucks, floor trucks, skid platforms, stackers, portable elevators, and steel storage racks. This firm displayed unlimited enthusiasm about welding's many advantages which, in their case, have been discovered throughout 20 years of pioneering in its utilization. Thus, the electric arc is used for their trademark with good reason, though of course they resort to gas for cutting. Jigs and fixtures are used for all of their welding;



Welded Pressure Filter for Dewaxing Oil.

(An 840-sq. ft. Rotexo filter made by the Oliver-United Filters Co., Oakland, Calif., for the Atlantic Refining Co.)

and every design for their products is carefully worked out to achieve strength where it is needed most, rather than merely to allow dispositions of the metal for the benefit of the machinists, as would have to be the case without the advantages of welded construction. Examples of this are their various lift-truck platforms, wherein four different angles from several planes are held in a permanently rigid and solid construction by means of only a single weld—a feature that has proved so efficient and satisfactory under the severest kinds of abuse, that it has been patented by the company. In fact, this company's designs are all so carefully thought out, that bolts for even removable parts are almost entirely eliminated — ingenious features of welded construction being resorted to, instead, in order to give accessibility, or to satisfy dismantling requirements. Sales as the direct result of such engineering thoroughness ought to be exceptional, especially when one remembers that material-handling equipment never receives any of the servicing and attention accorded to most other kinds of apparatus and machinery. Certainly no reason could be more important for purchasing welded equipment of this class, instead of riveted and bolted designs. The Barrett-Cravens Co. evidently agrees with this conclusion, because their material-handling equipment also makes use of welding quite generally.

Arc-Welded Snowplows Are Proving Money Savers

By A. F. DAVIS

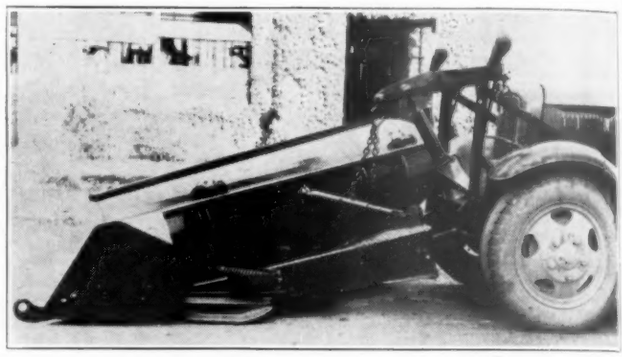
Vice President, Lincoln Electric Co.

Fabricated into rigid steel units, arc-welded snowplows are showing highway departments a way to save money. Even when traveling at high speeds, such snowplows are impervious to the shaking and severe stresses which soon develop joint-looseness in riveted designs. Hence, maintenance costs are lower, according to claims by Carl H. Frink, Inc., Clinton, N. Y., makers of such equipment.

The welded construction of such a plow can be seen in the accompanying picture. The frame consists of angle sections of sizes from 3x3x3/8 in. up to 6x4x1/2 in., depending on the plow capacity. These are welded together, and to this framework is welded the mold-board, formed to the correct shape from 12- to 8-gauge steel sheets. The body of the plow consists of angle sections in sizes from 2x2x3/16 in. up to 7x3 1/2x5/8 in. and plates of 12- or 11-gauge thickness.

High ductility and high-yield joints, features of these snowplows, are obtained through the use of the shielded-arc welding process. It is claimed that welded joints made by this method have a resistance to vibration-caused fatigue stresses which is even higher than that of the steel itself.

The welded type of snowplows not only give a superior performance, but have a more simple construction consisting of parts welded directly together, and being free from all connecting members, they are susceptible of faster production for the manufacturer.



Arc-Welded Snowplow Made by a Clinton, N. Y., Manufacturer.

(Such a plow is proof against joint-looseness from shaking and stresses.)

Packaging, Bottling Machinery Fields Still Unexploited

The "Chem Show" this year seemed to reveal only one large general field or class of equipment wherein it appears to be necessary that the welding profession's sales engineers pump up to full pressure and go to work with "everything they've got." We are speaking of packaging and bottling machinery, which perhaps requires more adjustable features than almost any other kind of equipment. All its component parts are usually bolted together, and necessarily consist of many different interchangeable castings in an astounding variety of sizes, in order to be adaptable to all kinds and shapes of bottles and packages. Moreover, one of the imperative demands imposed upon such machines is that their designs admit of a ready substitution of new or service parts in cases of breakdown. Certainly everyone who has ever observed bottling machinery in commercial operation realizes what a "bottle-neck" such equipment would become in a production schedule, if taken out of operation for even a few moments for only a minor adjustment.

Lest we forget—congratulations and "more power" to the Roots-Connersville Blower Corp. The occasion for this well-wishing is the new clean-cut design and sturdy welded construction of the Harrison Inert Gas Producer, which is being built and promoted by them.

And, "believe it or not," we now are signing off this "broadcast" about welding progress with calling Ripley's attention to the fact that the only exhibit which failed to get a lot of attention at this year's exposition was that of the Government's National Housing Commission, which was endeavoring to show chemists how to borrow up to $50,000 of Federal Modernization Credit (without regrets). The woods are full of progressive chemical engineers who save their employing companies that much money every year through the economies and advantages of welding alone.

Large Repair Job on Pumping Equipment

A large crankshaft and engine base has been brought to The Superior Welding Co., 331 Knoxville, Peoria, Ill., from the Liverpool Pumping Station, Liverpool, Ill., for repairs. It is 12 ft. long, weighs little over a ton, and has 7 1/4-in. bearings, which are to be repoured and line bored. Cracks in this shaft are to be welded with shielded-arc electrodes. Another crankshaft from the same place was repaired by this company about a year ago. It was the same size and has been in constant use since then. Immediately after repairs were made and this crankshaft replaced it was put to a severe test by using it 24 hours a day for three months. H. D. Wiese, proprietor of The Superior Welding Co., Mr. Shoff, of McBride and Shoff's Machine Shop, and the board of directors in the vicinity of Liverpool, recently inspected it and found that bearings and all are in perfect condition. The second shaft, now in process of repair, is to be machined by McBride & Shoff, 320 Knoxville, Peoria.

Technical Papers Solicited for International Congress

In connection with the Twelfth International Oxyacetylene Congress, to be held in London, England, in June, gold and silver medals are being offered for the best papers submitted on various technical subjects. All papers are to be received by the Secretary, at 639 Grand Buildings, Trafalgar Square, London W. C. 2, not later than April 15. This Congress marks the 50th anniversary of the industrial production of oxygen and the centenary of the discovery of acetylene.

Modern Business Methods Are Necessary for the Modern Job Shop

By DAN E. RANDALL

THE job-shop, as we have known it in the past, has nearly reached the end of its rope. That early era in commercial welding, where a shop owner operated his business in some dilapidated shack down a dark alley, is rapidly coming to a close. In order to keep the word overhead out of his vocabulary a commercial welder can no longer trust his customers to beat a path to his door. Now, there are other welders, and handier doors. No longer can he estimate job costs by replacement costs and make his customers pay one-half or one-third of that amount. The golden age in job-shop welding is gone forever.

There are a number of factors which have contributed to this change. The constant expansion in the field of welding is the chief reason. Factories and garages that used the commercial-welders' service exclusively in the past have bought their own equipment and trained their own men. These conditions have forced the shop owner into new fields. In order to make new customers he had to get out of the alley into a good location. He has adopted modern methods of price setting on a cost-plus basis in order to meet the rates of his increasing number of competitors. If he is alert and expects to survive, he advertises extensively both his location and the services he offers. He adds portable equipment and changes his outlook from that of a back-alley job-shop operator, to that of a welding contractor; for he is a contractor in this field whether he likes it or not.

Selling the services of a welding shop has become a merchandising proposition. It must be handled by up-to-date methods in the same manner in which a large mercantile house sells its goods. In addition, a shop owner has to be doubly careful that he gets all he can for his money, for he usually has all too little to spend.

To Get Business Modern Shop Needs a Good "Front"

"Front" means as much to a job shop owner as to a confidence man. A proper location for his business is the first step in this direction. Next he must choose some outstanding service which he is prepared to offer the public; then advertise both location and service thoroughly.

There we arrive at the paramount question. What type of advertising should he choose? The cost must be low, for he cannot spend over 5% of gross receipts in this manner. It must also reach the greatest number of people who would use the services he offers. A job-shop owner can make or break himself on the kind of advertising he buys. Hardly a day goes by but what he is solicited for its purchase in one form or another.

Should Select Advertising Schemes Carefully

Of course, the medium he should select depends upon the community in which he operates and the type of customer he seeks to attract. Nevertheless, there are any number of advertising schemes afloat which are practically worthless to him. One among these is the editorial splurge sold over the telephone and published in some small weekly or even the daily newspaper. The cost of this type of advertising is high; his money goes largely to some outside concern; and the flowery language in which the history and achievements of his business is couched is seldom read by the public. Then there are theater programs, theater curtains, poster signs in filling stations, labor temples, barber shops and shine parlors. Time books, trade magazines (published locally), and charity advertising of all kinds are poor mediums of advertising for a welding contractor.

The best type of advertising for his business, if the owner can afford no other, is the classified section of his local telephone directory, or any outlying directory in the territory from which he may reasonably expect to draw business. The yearly rates in the classified section of his local newspaper is his next best bet if he wishes to reach the town customer. The local radio is also an excellent, though somewhat expensive, medium. If, on the other hand, his prospective customers are largely rural, there is only one sure way to reach them all. That method is by direct-mail letter.

As an example: a job-shop owner holding the exclusive application for rebuilding some agricultural implement in a given territory, wishes to reach some three thousand farmers with his message. Naturally, his first task is the composition of a letter setting forth the merits of the product he is marketing. If he is unequal to this task he can have it composed for a nominal fee. His next step is to have it printed under his own letterhead with typewriter type. The cheapest of bond paper will suffice for this job. In the meantime he consults his local postmaster as to the cheapest method of placing these letters in the hands of the rural box holders. He is told he may purchase a permit for $10 and pay for his letters by the pound. This system is fine for a large mail-order house, but for his three thousand letters the advertiser's cheapest way out is to purchase pre-canceled 1½c stamps. Next, have "Rural Box Holder" printed on the envelopes along with the permit number; then affix the stamps, stuff the envelopes, turning the flaps under. The next step is to tie them in bundles of fifty or less and tag them for the post office from which they will be distributed. The postmaster will furnish him with a list of the number of rural box holders receiving mail from the various post offices in the territory he wishes to cover. If his letter contains the proper appeal he has made himself a lot of customers, for the farmer reads his mail.

There's Money to Be Made From a Well Chosen "Leader"

Many a shop owner will say: "What can I use for a leader?" Every welding operator has at least one operation in which he especially prides himself. Why not play up this operation to your public? Every town or city has water service today. Water service means hot-water heating tanks, which means leaky tanks occasionally. A good bronze weld conmpletely around the bottom of these tanks will renew their life once more at a fractional cost of replacement. You won't get any help from the plumber who is out to sell new ones, so you must advertise this service yourself. Once the property owner finds he can save two-

thirds the cost and have a guaranteed job, you will have plenty of them to do. Not only that, but there is a leader for your advertising. A leader is something definite with which the public can associate the services you offer.

Many shops throughout the West stress the welding of automobile flywheel teeth while still in the car. This is not a difficult task for a skilled operator and it makes a wonderful leader. The public reasons that if you are able to do the difficult job, you should be that much better on the simple one.

Hard-facing is coming into greater demand each year and the wide-awake shop-owner will stress this kind of welding to road contractors, quarries, lime-pulverizing outfits and countless other operators of machinery. Hard-facing is also a good leader, and its successful application will build prestige for you quickly.

Personal Solicitation One of the Best Selling Methods

There is still one type of advertising which costs less in dollars and cents than any other. The shop owner spends nothing but time, and time is of no value unless he is busy. If he is busy continuously, he doesn't need to advertise. The medium referred to is personal solicitation. In other words, the welder must drop his torch and become a salesman. Not only that, but he must sell a product that requires real salesmanship, for he is selling service. In selling service you are offering an intangible to your customers. It is not something they can pick up, turn over and compare in quality and price with a product of your competitor. It is something that is represented by yourself, by what you say, by the confidence you instill; in short, by your personality. If a job-shop owner can develop this type of salesmanship and apply it, he will find it is his best method of securing business. When he is in the establishment of a prospective customer he has an opportunity to observe welding needs. He may profitably suggest services which the customer doesn't know he can secure.

Shop Proprietor Must Be a Salesman of Service

The operator of a modern welding job-shop is, first of all, a contractor securing a large percentage of his work on a competitive basis. Secondly, he must train himself in modern methods of operating this business on a cost-plus basis. Last, but by no means least, he must teach himself how to sell the only product he has to offer if he is to survive in this rapidly changing picture. He must become a salesman of service. In that manner he not only helps himself but the industry as a whole.

Increases Draft of Old Snow Plows

By having plates welded along the top of their old snow plows, the Wells County (Ind.) Highway Department have increased the capacity of their snowplow equipment. The work was done by Huffman Bros. & Gavin, of Bluffton, Ind.

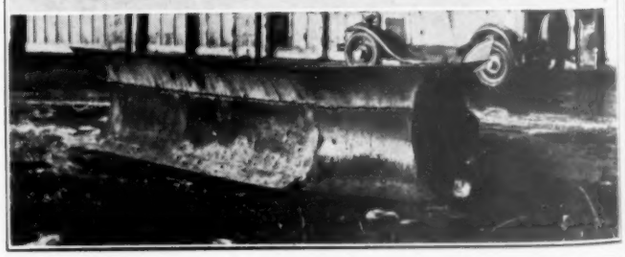
These plows were purchased several years ago when the county had trucks, with solid tires, which could not handle a higher plow. But now the county has a fleet of trucks with dual pneumatic tires in the rear, which give much greater traction and will handle a greater draft of snow.

Therefore, it was decided to increase the depth of the old plows by curving ¼x14-in. plates to meet the same slope as the old plow sides, and are welding them along the top of the plow, overlapping the top edge about 2 in. Then plates were cut and are welded to the inside to form ribs to take the stress when the plow starts to roll snow.

The wings of these plows can be spread out so that in a light snow the road can be opened in one trip.

The plow before its capacity was increased.

14-in. strips welded in place. Note braces at back to take up stress while plowing snow.



Plow ready for action in deep drifts. Welding has saved the price of a larger outfit.

St. Louis Welding Society Celebrates Fifth Year

The St. Louis Welding Society in January celebrated its fifth anniversary. At the start there were only six sustaining or firm members and about 25 individual members. Today, there are 73 sustaining members and 30 individual members, reports Lockwood Hill, executive secretary. A sustaining membership by any company entitles all men in its employ to attend the meetings, without the necessity of their taking out individual memberships. Sustaining members pay $5 per year, and individuals $1. All officers serve without salary.

Meetings are generally held one evening a month in the auditorium of the Gallaudet School, 1604 S. Grand Blvd., with an average attendance of about 150.

Meetings of Interest to the Welding Field . .

Chicago

The welding of stainless steel, nickel and nickel alloys will be the subject under consideration at the meeting of the Chicago Section, American Welding Society, to be held at Mission Hall, Armour Institute, Friday, Mar. 27.

Beginning at 8 p.m., a sound motion picture on the manufacture, fabrication and application of "Enduro" stainless steels will be shown through the courtesy of the Republic Steel Corp., and V. W. Whitmer, of that company, will give a talk on welding problems in connection with stainless steel.

The welding of nickel, nickel-clad steel, Inconel and monel metal will be covered in a talk by F. G. Flocke, of the development and research department of The International Nickel Co., Inc.

At 7 o'clock, Jules Muller will continue his series of lectures on "Metallurgy as Applied to Welding," and this will be preceded by a dinner at 6 o'clock, which will also be in Mission Hall.

Lawrence, Kan.

Several members of the faculty took part in presenting papers and giving demonstrations before the Second Welding Conference held by the University of Kansas, at Lawrence, Kan., on Mar. 12 and 13. Of particular interest was a paper on "The Design and Testing of a Vierendeel Girder," by Geo. W. Bradshaw, of the University faculty, the test being conducted in the Laboratory of Applied Mechanics, using a 100,000-lb. testing machine for applying the load. Three papers on the program were devoted to a.c. welding, with comparisons made between it and the d.c. process. The registration was 115, of which 30 were students.

Los Angeles

At the meeting of the Los Angeles Section, American Welding Society, held on Feb. 20, F. C. Fantz, vice-president of the Midwest Piping & Supply Co., Los Angeles and St. Louis, spoke on "Welding as Applied to Pipe Fabrication." Fred Huston, development engineer, International Nickel Co., followed with a good talk on "Fabricating of Clad Steel Plate," in which he covered the development of manufacturing methods and procedure for fabrication of clad steel, illustrated by lantern slides.

The March meeting of the Los Angeles Section is scheduled for the evening of the 19th in the Los Angeles Chamber of Commerce Building and will be preceded by the usual dinner. Wilson P. Hunt of the Moline Tool Co. will speak on "Influence of Welding on Machine-Tool Structures."

At a special meeting of the executive committee of this Section on Jan. 14, the following committees were appointed for the coming year:

Program: P. D. McElfish, Standard Oil Co. of Calif.; G. S. Parsons, Lincoln Electric Co. Membership: F. C. Emery, Air Reduction Sales Co. Qualification of Welders: Frank Howard, Smith Emery Co. Piping Code: J. J. Bruton, Oxweld Co.; J. V. Horne, Union Oil Co.; B. Laulhere, Southern California Gas Co.; F. C. Emery, Air Reduction Sales Co. Pressure Vessels: Lloyd Earl, Consolidated Steel Co.; Wayne Howard, General Petroleum Corp.; P. Sterkel, steel plant superintendent; C. P. Sanders, Western Pipe & Steel Co. Structural: R. W. Binder, McClintic-Marshall Co.; Paul E. Jeffers, Structural Engineer; G. J. Carroll, Consolidated Steel Corp.; Wayne Howard, General Petroleum Corp.

Milwaukee

New trends in the application of welding in the heavy machinery and automobile industries, was the subject of an illustrated talk by K. L. Hansen, consulting engineer, Harnischfeger Corp., given before a meeting of the Milwaukee Section of the Society of Automotive Engineers, held on March 2.

Minneapolis

The gymnasium of Dunwoody Institute, Minneapolis, Minn., was the scene of the annual "Welding Confab" held by the Commercial Gas Co., of the same city, on Mar. 4 to 7. Lined up along one side of the huge hall was a series of arc-welding booths, and along the other side were welding tables, each booth and table being in charge of a competent combination welding operator—a specialist in some phase of welding. Whether cast iron, preheated castings, aluminum and white metal, hard-facing, manganese steel, or whatever the visitor might be especially interested in, he could easily find the booth or table devoted to the particular specialty, since each was legibly labeled with the name of the product or type of welding being demonstrated. The total attendance for the four days was 2470, of which 750 were trade school students. This represented an increase of 883 over last year's "Confab."

New York City

"Welding in Shipbuilding" is the subject of the meeting of the New York Section, American Welding Society, to be held on the evening of April 14, in Room 501, Engineering Societies Building.

Low alloy, high tensile steels, their design, fabrication, welding qualities, corrosion resistance and other properties, were covered at the March 10 meeting of the New York Section. A. B. Kinzel, chief metallurgist, Union Carbide & Carbon Research Laboratories, discussed the subject with particular reference to the metallurgical problems involved, and H. M. Priest, engineer, Railroad Research Bureau, detailed the applications of these steels, and stressed the need for improved engineering design in employing them and the necessity of exact stress analysis to secure fullest benefits from their use. A large number of charts, graphs, illustrations of all-welded Diesel engines and all-welded railroad rolling stock, including hoppers, box cars, passenger coaches, etc., were shown upon the screen.

Omaha

The 3-day "Welding Confab" held by the Omaha Welding Co. on Mar. 11 to 13 closed with a total registered attendance of 280, which represents an increase over last year's attendance.

Philadelphia

Lt. Comdr. H. N. Wallin, of the U. S. Navy, will address the Philadelphia Section, American Welding Society, on the

View of Commercial Gas Co. Clinic, Dunwoody Institute, Minneapolis.

(Note the stove-pipe decorations in front of the arc-welding booths along the right wall, dressed up to represent huge coated electrodes of standard brands. The company's new display rack is also shown in the front of the photograph.)

evening of April 20. His subject is "Some of the Problems Which Arise in Connection With Electric Welding in Ship Construction." The meeting will be held in the auditorium of the Engineers Club, at 1317 Spruce St. At the meeting on March 16, Dr. J. C. Hodge, of The Babcock & Wilcox Co., gave an illustrated lecture on "Fundamentals of Good Welding," with particular reference to the welding of pressure vessels.

Pittsburgh

E. W. Forker, manager of the process equipment division of the Blaw-Knox Co., Blaw-Knox, Pa., addressed the Pittsburgh Section of the American Welding Society, Wednesday evening, Feb. 19, on "Welding of Process Equipment."

San Francisco

The February meeting of the San Francisco section of the American Welding Society was held Friday evening, Feb. 28. In addition to the transaction of routine business, Edgar Brooker, metallurgist for the Standard Oil Co. of California, spoke on "Welding Under Water."

St. Louis

March 13 was "Operators' Night" at the meeting of the St. Louis Welding Society, and the scheduled speaker was A. F. Davis, vice-president of The Lincoln Electric Co. and editor of the operator's magazine, the *Stabilizer*. Later in the year, visits to the Heine Boiler Co. and the St. Louis Car Co. are planned.

Series of Clinics for Iowa and Nebraska

A series of educational demonstrations of profitable oxyacetylene welding is being given throughout Iowa and Nebraska by the Balbach Co., of Omaha. Included are auto, truck and tractor motor-block welding, head and valve-seat welding, welding and heat-treating of steel, bronze welding of cast iron, and simplified method of preheating.

The first of these demonstrations was scheduled to be given on Mar. 18 at the Creston Auto Co., Creston, Iowa, and the second one on Mar. 20 at the Charley O. Neils Shop, in Winterset, Iowa. Others at other locations will follow.

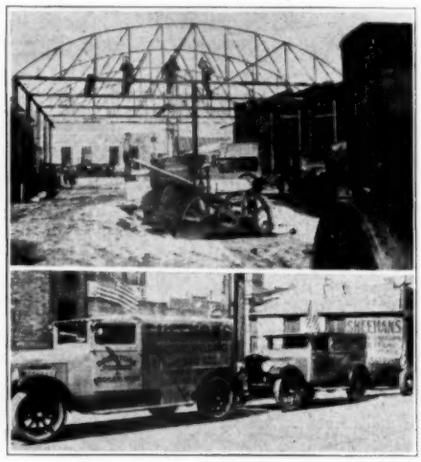
Power Conference Includes Papers on Welding of Pipe

"Power Piping and Welding" is the subject of one of twelve sessions to be held during the Midwest Power Engineering Conference, at Chicago, Apr. 20 to 23. The session on piping will be held at 9:30 a.m., Wednesday, Apr. 22, in the Palmer House. Subjects of papers are: "Valves," "Power Plant Piping," and "Welding of Alloy Steels and Pipe." An exposition of power-plant equipment will be held concurrently in the International Amphitheatre.

New Welding Shop Has All-Welded Frame

An all-welded shop frame, 43x75 ft. in ground area, has been built by Sheehan's Welding & Radiator Shop, in Idaho Falls, Idaho, for their new building. The roof trusses are constructed of 5½- and 2-in. superheater tubes, and are supported on structural-steel columns.

The shop has a concrete front, heavy corrugated galvanized steel roof, and the ceiling metal lathed and plastered. A traveling crane runs the full length of the building, and there are two 20-ft. swinging cranes. Cranes and framework are all-electric-welded. W. H. Sheehan states that he intends to install a frame-straightening and wheel-aligning machine.



(Top) Erecting Welded Framework for Sheehan's New Welding Shop, at Idaho Falls, Idaho.
(Bottom) View of Shop's Portable Welding Equipment.

Hold Clinics on Welding of Non-Ferrous Alloys

A series of welding "clinics" to demonstrate the best methods for welding various non-ferrous metals and clad materials will be held in four West Coast cities during April. Included will be practical problems involving the latest methods of both electric and oxyacetylene welding and brazing on monel metal, aluminum, nickel, copper, brass, bronze, Inconel, and nickel-clad steel.

The "clinics" will be conducted by welding engineers of The International Nickel Co., Aluminum Co. of America and Revere Copper and Brass Incorporated. They will be held as follows: April 3 and 4, at Wilkinson Co., Ltd., 190 West 2nd Ave., Vancouver, B. C.; April 10 and 11, at Eagle Metals Co., 21 Spokane St., Seattle, Wash.; April 17 and 18, at Pacific Metals Co., Ltd., 3100 Nineteenth St., San Francisco, Calif.; and April 24 and 25, at Pacific Metals Co., Ltd., 1400 S. Alameda St., Los Angeles, Calif.

Acknowledgment for Material and Photographs

In the article on "Flame Cutting" by Arland Ussher, which appeared in the November, 1935, issue of *The Welding Engineer*, we omitted to state that the author made grateful acknowledgment to the African Oxygen & Acetylene (Pty.) Ltd. (subsidiary of the British Oxygen Co.) for the loan of the photographs, and to C. G. Bainbridge and E. J. Clarke for some extracts from their papers.

All-Welded Manipulator Weighs 787 Tons

By EDWARD H. SYKES
Pittsburgh Correspondent, *The Welding Engineer*.
(*See illustrations on next page.*)

A new, all-welded manipulator weighing 1,575,000 lb., composed of 1,975 separate pieces of steel from 2½ to 20 in. thick, requiring 42,000 lb. of coated welding rod in its manufacture and containing 16,000 linear feet of electric welds, has been installed by the Jones & Laughlin Steel Corp. in its new 44-in. blooming mill in Pittsburgh.

This 787-ton machine, made for the automatic handling of steel ingots, was built by The Morgan Engineering Co. in its Alliance, O., plant, and was designed for welding from top to bottom. It was assembled in four separate units, the overall dimensions of these being: Length, 93 ft.; width, 53 ft.; height, 21 ft.

Rolled steel was used almost to the exclusion of forged steel, although a little of the latter was employed. The only steel castings were the side-guards and operating cylinders. It is well known that the use of rolled steel guarantees uniformity of density and a minimum of defects. All units of the structure were stress-relieved before machining.

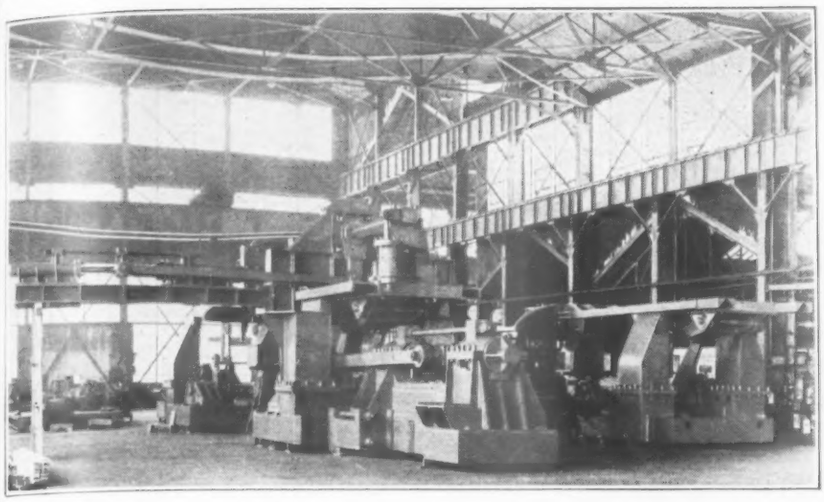
About six months was required to design and build this manipulator, which will be in operation early this spring.

The new manipulator will be hydraulically operated, the only other manipulator of this type also being owned and operated by Jones & Laughlin.

The Morgan Engineering Co. also recently completed building a 51,000-lb. all-welded piercing press base for the Jones & Laughlin Steel Corp., which is now in operation in the corporation's Aliquippa plant. This unit also was stress-relieved before machining.

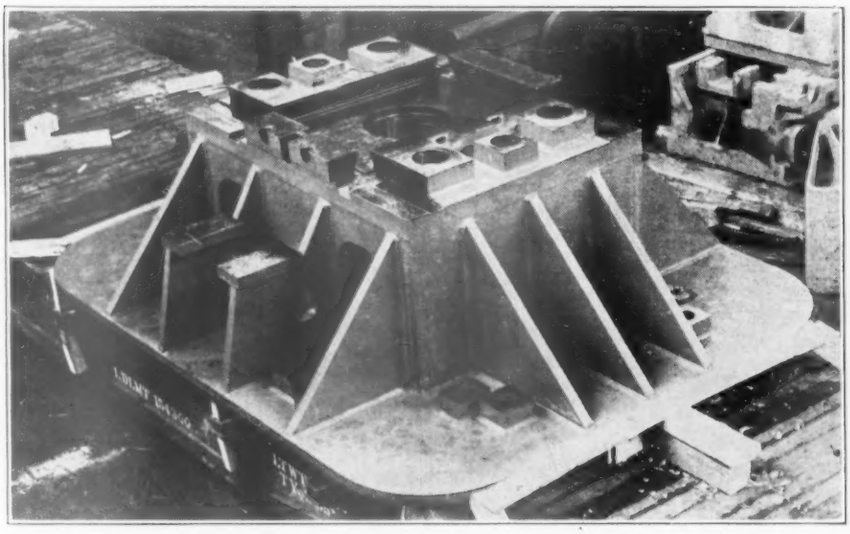
Views of Welded Manipulator

(See Story on Opposite Page)

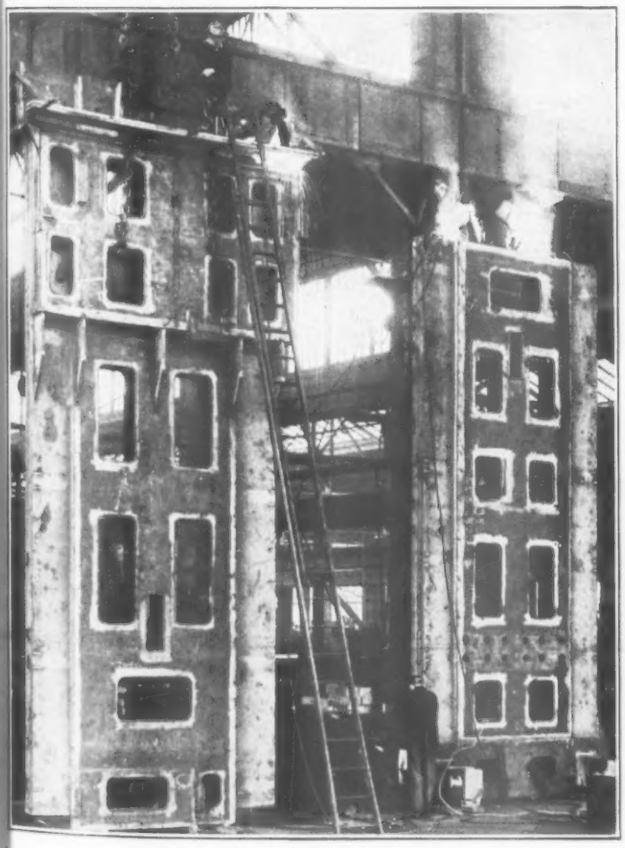


Manipulator for 44-in. blooming mill. Manufactured by the Morgan Engineering Co., Alliance, Ohio, for the South Side (Pittsburgh) Works of the Jones & Laughlin Steel Corp.

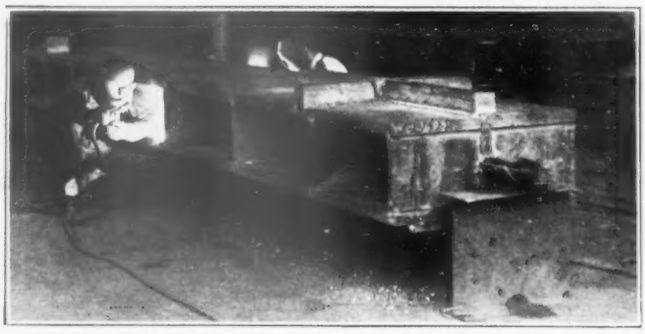
Operator welding main base.



Another example of welded construction. A base for a piercing press, also manufactured by Morgan Engineering Co., for the Aliquippa Works of the Jones & Laughlin Steel Corp.



(Left) Welding platens for 787-ton manipulator.



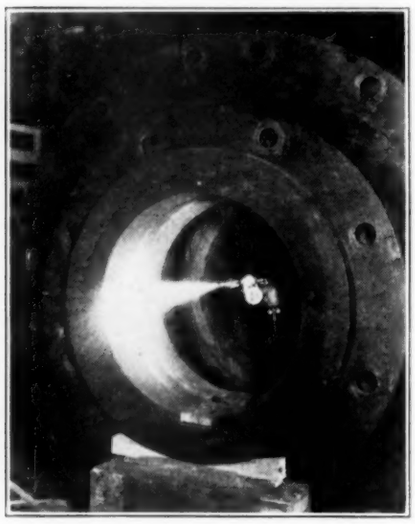
Finger operating cylinder base for manipulator.

Notes on Metal Spraying

Builds Up Worn Cast-Iron Hub

The 43-in.-diameter bore of a cast-iron hub, in two sections, was built up after severe wear by metal-spraying with low-carbon steel and then truing up in a boring mill, the work being performed by The Metal Spraying Corp., 3610 W. Pierce St., Milwaukee, Wis.

These two hub sections were part of a 20-ft.-diameter flywheel on an engine employed in pumping water. The engine stopped quite suddenly one day, causing the flywheel to shear a 5-in. key in two and continue turning on its shaft,



Spraying Hub Bore With Carbon Steel.

with the result that the bore of both sections of the hub was worn about 0.020 in.

The shaft was checked, and it was found that it still would run true, so it was decided to have the bore of the hub sections built up by metal spraying to their original diameter.

In preparation for applying the metal, the castings were set up on edge and bolted together, as shown in the illustration, to give easy access to the worn parts. Then the keyways were blanked off with blocks of wood. The next step was to throw a canvas tent over the entire casting, under which the workman roughened the worn surfaces by blasting with steel grit. Then, using a 1/8-in. low-carbon-steel wire, a coating approximately 0.015 in. thick was sprayed over the worn surfaces of both hub castings.

With the spraying completed, the wooden blocks were removed and the castings were chucked up on a boring mill and trued up according to their outer edge. The bore was then machined to size by a toolpost grinder clamped in the boring-mill tool holder and fed up and down to grind out the excess sprayed metal. Sufficient stock was left in to make the proper press fit for a 43-in. shaft, and the hub sections were pressed on the shaft without difficulty.

The total cost of the job was less than $200. Engineers estimated an approximate cost of $5,000 to replace the hub sections with new castings, as this would have involved new patterns and the castings would have had to be machined to fit the old spokes and rim, and also considerable time would have been involved. This being a breakdown job, it was important that the repairs be made as speedily as possible.

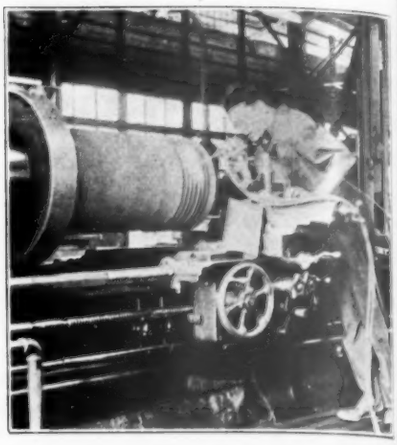
Coating Cylindrical Parts on Lathe

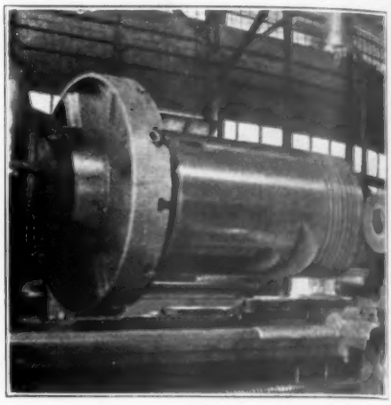
The building up of shafts, pistons, rolls and other cylindrical parts is facilitated by rotating the part in a lathe and metal spraying with the building-up metal. The spray gun can be mounted on the tool carriage. In this manner, an even thickness of the metal is applied around the entire circumference.

Applications of this kind are numerous, but several jobs of especial interest have been completed by the Metallizing Engineering Co., Inc., 205 W. Wacker Drive, Chicago, Ill., and are described here.

One of these involved the building-up of a tug-boat propeller shaft with two different metals—high-carbon steel for the inboard bearing and 18-8 stainless steel for the outboard bearing. This particular application overcomes a troublesome form of corrosion that cannot be combatted by the use of one metal alone,

Building Up Tug-Boat Propeller Shaft.
(Spraying high-carbon steel on inboard bearing, with outboard bearing built up with 18-8 stainless. Stainless on the near side.)





Repair of Gas-Engine Piston.
(Top view shows spraying of Norway iron to build up diameter 1/8 in. Bottom view shows piston after grinding, prior to recutting the ring grooves.)

as the 18-8 is too soft for the inboard and the high-carbon will corrode rapidly on the outboard.

Worn gas-engine pistons have been been built up, then ground to size and the ring grooves re-cut, by this firm.

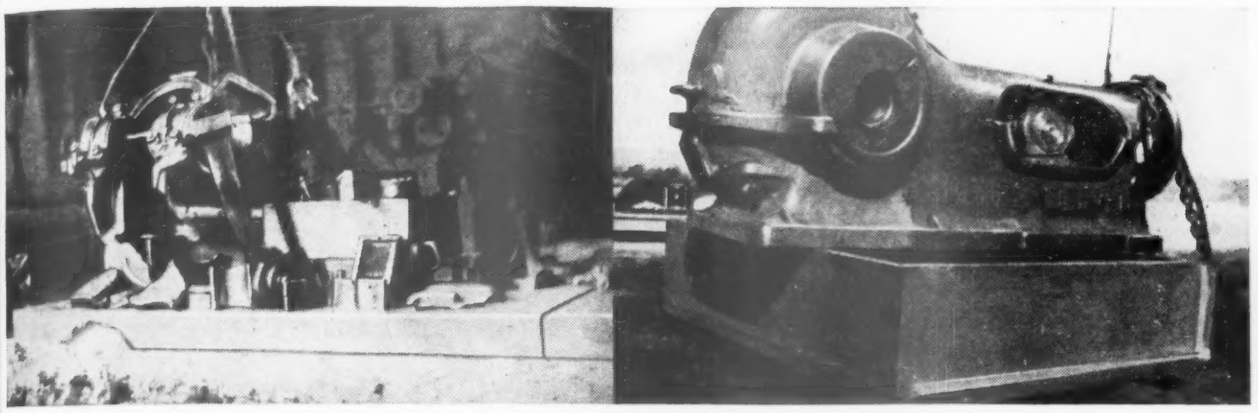
Cast-iron mold cores for the manufacture of concrete pipe are subjected to severe abrasion in service. These have been metal sprayed with high-carbon steel, which provides a surface that will resist abrasion to a far greater extent than does the original cast iron.

A large crankshaft for an air compressor was built up on the bearing surface and on the flywheel press fit, the job being completed and re-installed in the compressor in less than two hours.

Dubbs blower shafts have been built up with air-hardening stainless steel, and in every case the "Metallized" shaft has given longer life than the original shaft.

Large savings have been effected by building up armature-shaft bearings, and then turning them down to size. This eliminates the need for carrying numerous odd-size bearings on hand. By using high-carbon steel, an exceptionally good wearing surface is obtained, which will outlast the original. It is not necessary to remove the wiring or commutator.

How
TOBIN BRONZE WELDING
"picked up the pieces" and saved nearly $3,000



The illustration (left) shows the air-compressor *before* being repair-welded with Tobin Bronze. At right the compressor *after* Tobin Bronze had done its work.

THERE were plenty of pieces. For this 6,000 lb. air-compressor, belonging to a gold mining company, shattered into *65 fragments by actual count.*

To replace it with a new compressor would have cost $3,000... in addition to the time and money lost by the delay.

Repair-welded without pre-heating in 15 hours... with Tobin Bronze

An experienced bronze welder was called in. He examined the broken base plate and the shattered hood. The problem was plain. Only a low temperature rod, which would eliminate pre-heating, could be used. He used Tobin Bronze . . . and saved the necessity of buying a new compressor.

In only 15 hours, welder and helper completed the repair-welding necessary. The pieces were joined together in sections, and each section was allowed to shrink before being "assembled." 36295

Time and again Tobin Bronze has proved the *ideal* welding rod for difficult jobs on cast and malleable iron by making satisfactory repairs at low cost, which would otherwise have been impossible. Experienced welders know this. Many of them depend on the uniformity and consistent high quality of Tobin Bronze and will use no other brand.

Tobin Bronze carries the trade-mark "Tobin Bronze Reg. U. S. Pat. Off." in each rod. Look for this trade-mark and make certain that you are getting *genuine* Tobin Bronze!

MELTING POINTS OF ANACONDA WELDING RODS

Material	Approx. Melting Point—Degrees Cent.	Fahr.	Material	Approx. Melting Point—Degrees Cent.	Fahr.
Tobin Bronze*	885	1625	Phosphor Bronze D	1000	1832
Manganese Bronze	870	1598	Phosphor Bronze C	1025	1877
Brazing Metal	930	1706	Silicon Copper	1083	1981
Economy Bronze*	885	1625	Deoxidized Copper	1083	1981
Everdur*	1019	1866	Electrolytic Copper	1083	1981
Anaconda 520	885	1625	Super Nickel	1225	2237
Phosphor Bronze A	1050	1922	Nickel Silver	1055	1931
Phosphor Bronze E	1070	1958	Ambrac*	1150	2102

*Trade-marks Reg. U. S. Pat. Off.

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ANACONDA WELDING RODS

What's New in Equipment and Supplies

Senior Duro Holder Makes Its Bow

A new electrode holder for heavy-duty welding, known as the Senior Duro Holder, has been announced by the Churchward Engineering Co., New Haven, Conn. In this holder are incorporated such features as interchangeability of all parts, precision assembly and light weight. The manufacturers also announce the use of a new alloy in the jaws of both types of Duro holders. This new alloy is said to give most excellent results in service, and under tests the jaws have stood up unusually well under heavy work.

New 75-Ampere Welder Has Stable Arc

The outstanding feature of the new 75-ampere vertical welder announced by the Harnischfeger Corp., Milwaukee, Wis., is the extremely stable high-speed arc, accomplished through combining the magnetic bridge as a part of the main-pole assembly and spreading pole shoes wider around the holes in which the stabilizer coils are embedded. Actual service tests and oscillograph recordings show that this change in generator design has resulted in a still greater degree of current uniformity.

Mounted atop the generator of this newest P&H-Hansen model is a heavy-duty, 5-hp. squirrel-cage motor of drip-proof construction. This fan-cooled motor is operated by push buttons and equipped with no-voltage release and overload protection. Connections are available for 110 to 550 volts or for special voltages of 2 and 3 phase, 60 and 50 cycles. Single control is provided for current settings over the entire welding range to reduce dependence on the human element.

The unit is capable of handling work as light as 24 gauge, answering the new demands for welding among manufacturers of metal furniture, furnaces, kitchen utensils, steel sash, containers, etc. It is claimed to produce uniformly strong welds even with stainless steel and non-ferrous alloys. It is 15½ in. in diameter, 41 in. high and weighs 600 lb. It is furnished with stationary or wheel truck mountings or with lifting bail.

Portable Small-Capacity Welder.

Meter for Measuring Current of Resistance Welders

Resistance-welding currents can be measured by means of a new instrument brought out by the Welding Timer Corp., 251 Ogden St., Newark, N. J. This measuring device consists of a through-type current transformer, a rectifier, a condenser bank and a very high-resistance meter, contained in a metal case 10 x 12 x 5 in. in size. The current transformer is separate from the case. The device is light in weight and is sufficiently rugged to be readily portable.

To obtain a reading, the main power lead of the welder is passed through the current transformer in the usual manner. When the welder is operated, the voltage appears across the terminals of the current transformer and charges the condenser bank. The impedence of the rectifier is sufficiently low that the condenser becomes fully charged within about one cycle. The high resistance of the meter circuit delays the discharge of the condenser for a sufficient length of time to allow the meter to deflect to a position corresponding to the current in the mains. The meter drops back very slowly so that its maximum swing can be read very easily. There are three current ranges, permitting readings from 0 to 1500 amperes, which cover the majority of spot-welding currents.

Current-Measuring Device.

Trade Literature

A new edition of "Your New Plant: Multistory or Single Story—Which?" has been issued by the Austin Co. of Cleveland, well known among building organizations for its advocacy of the use of welding in building work. The pamphlet compares in detail the various construction and operating costs of multistory and single-story structures, with particular emphasis on the utilization of floor space in the two types. Copies of the new edition can be obtained from the headquarters office in Cleveland, or from any of the eleven district offices.

Welders' gloves, electrode holders, welding goggles and goggle respirators are included in a new 84-page catalog of safety equipment just issued by the Pulmosan Safety Equipment Co., 178 Johnson St., Brooklyn, N. Y. This catalog, which lists an unusually wide variety of wearing apparel and devices designed to prevent industrial accidents, is equipped with a handy filing marker labeled "Safety Equipment."

"How to Bronze-Weld" is the title of a booklet published by The Linde Air Products Co., 30 E. 42nd St., New York City, summarizing the available information on bronze-welding and bronze-surfacing. The booklet presents the fundamental theory and technique of the two processes, together with a discussion of their utility, and likewise the step-by-step general procedure for both. A wide range of other topics of general interest to welders is also covered.

Advantages of expanded steel studs for residence and business buildings in which the load carried is comparatively light, are described in the folder entitled "Bethlehem Steel Studs" just issued by the Bethlehem Steel Co., Bethlehem, Pa. One of the chief advantages, according to the folder, is that the metal framework of buildings so constructed is welded together, using no bolts or rivets.

An interesting discussion of the alteration of automobile generators to make them suitable sources of supply for

The Oxy-Acetylene Welder's Handbook

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Careful organization for oxy-acetylene welding is essential if the benefits of the process such as economy and speed of production and superior product are to be derived. Such fundamental subjects as design, training operators, inspection and test are so handled to permit the organization of your welding department on a sound basis or to check up on your present operations.

For THE SUPERVISOR AND FOREMAN

Constant supervision must be exercised to know that your welders are producing sound work. Inspection and testing programs are outlined in a manner to help you determine whether good work is being done. Training schedules and suggestions are included to assist you in preparing new men for your department.

For THE WELDER

Success in the welding profession depends entirely on the operator's ability with the torch. Proven procedures for various operations are included together with suggestions for checking and improving your work without the aid of an expert.

CONTENTS:

CHAPTER I
The Welding Gases
Introductory — Oxygen — Calcium Carbide —Acetylene — Acetylene Generators — Dissolved Acetylene.

CHAPTER II
Welding Equipment
Regulators — Gauges — Hose — Torches— Goggles—Lighters—Fluxes — Grinders — Sand Blast — Asbestos — Preheating — Equipment — Welding Rods — Testing Welding Rods.

CHAPTER III
Setting Up Equipment
Procedure for Assembling Apparatus—Carbonizing Flame—Neutral Flame—Oxidizing Flame—Preliminary Exercises—Cost Factors in Welding.

CHAPTER IV
Methods of Welding
Thin and Thick Material—Flanged Edges — Rules for Good Welding — Forward Welding — Backward Welding — Rod Manipulation — Double Welding — Vertical Welding — Horizontal Welding — Overhead Welding — Swish Weld — Fadeaway Weld — Welding by Successive Pools.

CHAPTER V
Preparation for Welding
Design — Butt Weld — Caulking Weld — Fillet Weld—Flush Weld—Lap Weld — Strap Weld — Tack Weld — Types of Tank Seams — Bronze Collar Weld — Shear Vee Weld — Beveling — Expansion Preheating — Molds — Dished Patches — Cleaning.

CHAPTER VI
Inspecting the Weld
Penetration — Fusion—Adhesions — Undercutting — Incipient Cracks—Alignment—Buckling — Reinforcement — Hard Spots —Blowholes.

CHAPTER VII
Training Operators
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CHAPTER VIII
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CHAPTER IX
Testing
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Ryerson Green Processed No. 18
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Ryerson Bare Mild Steel
Ryerson Brown Processed
Ryerson White Flux Coated
Ryerson High Carbon White Flux Coated
Ryerson Blue Flux Coated
Ryerson 3½% Nickel Steel Flux Coated
Ryerson High Manganese Steel
Hyerson Hard Surfacing
Ryerson Allegheny Stainless Flux Coated
Ryerson Allegheny Stainless No. 44

GAS RODS

Ryerson Copper Coated No. 206
Ryerson Copper Coated No. 210
Ryerson Cast Iron
Ryerson 3½% Nickel Steel
Ryerson Tobin Bronze
Ryerson High Carbon Bare No. 2110
Ryerson Allegheny Stainless Bare
Ryerson Hard Filler

Write for Bulletin on Rods and Accessories

JOSEPH T. RYERSON & SON, Inc.

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welding current is contained in a special supplement published by Autopower, Inc., 408 S. Hoyne Ave., Chicago, Ill. Four chapters are devoted to the alteration of Model T Ford, Hudson, Buick, Cadillac and other generators, with numerous drawings and graphs.

The March issue of the Copper & Brass Research Association's Bulletin contains, besides many interesting pictures of the use of copper on early American roofs, a most instructive set of photos taken by an exploring expedition of the Metropolitan Museum of Art, showing copper forks, spoons and ladles from ancient Persia. Also depicted are various copper implements fashioned by American Indians centuries ago, and still serviceable.

Electrodes, arc-welding machines, and miscellaneous arc-welding apparatus are described and illustrated in a 32-page book recently issued by the Air Reduction Sales Co., 60 East 42nd St., New York City. Also included are tables of particular interest to the welder, such as an arc-welding table, a chart of recommended arc voltages, recommended amperages, approximate weights of Airco rods, and a summary of the causes of bad welds.

A complete description of the Taylor Forge seamless welding fittings and complete data covering prices, dimensions, weights and pressure-temperature ratings, are given in a new catalog of the Taylor Forge & Pipe Works, Chicago, Ill. Also more than 25 pages of important engineering information covering the flexibility of piping installations, illustrated with graphs and diagrams dealing with important case studies, are included.

"The New Hobart Arc-Welded House" is the title of a pamphlet issued by The Hobart Bros. Co., Box U-36, Troy, O., describing the fabrication and erection of a modern 5-room, welded, all-steel home, which it is expected can be duplicated at a price of $3,600, including plumbing and heating equipment, wiring and painting, foundation (less basement), and a $300 lot.

The new alternating-current welder, Type H, manufactured by the Owen Electric Manufacturing Co., Fayetteville, N. Car., is illustrated, and claims put forth for the newly developed arcless welding, in a folder issued by the company. Low operating cost, low open-circuit voltage, and high-grade welds with bare and lightly coated electrodes, are among the claims made.

Many new list prices on grinding wheels, effective April 1, are noted in the 54-page catalog, just put out by the Chicago Wheel & Mfg. Co., 1101 W. Monroe St., Chicago, Ill. An accompanying letter explains that price changes have been brought about by new methods and processes in the manufacture of grinding wheels.

"Improved Fabrication of 18-8 Chromium Steels" is the title of a pamphlet issued by The Linde Air Products Co., 30 E. 42nd St., New York City, setting forth improvements in technique and materials, welding procedure and simplification of fabricating problems.

A folder and price sheet describing the "Masterweld" shielded-arc a.c. electric welder has been issued by Master Welders, 2524 Holmes St., Kansas City, Mo. Prices are given for outfits ranging from 150 to 500 amperes capacity.

A small, colored folder on industrial wagon trucks for handling both hot and cold iron and steel products inside the plant has just been issued by the Lewis-Shepard Co., materials handling equipment engineers of Watertown, Mass.

Four varieties of AMSCO welding rods, made by the American Manganese Steel Co., Chicago Heights, Ill., are pictured in the catalog of the American Brake Shoe Foundry Co. Many other products are also listed.

Piece parts for Torchweld equipment are listed in a new catalog just issued by the Torchweld Equipment Co., 1035 W. Lake St., Chicago, Ill.

Commercial News

The Tri-State Welding Supply Co., with offices at 322 S. Main St., Memphis, Tenn., has been organized by J. R. Beckham and M. D. Sabin to conduct a welding-supply business. They have the Harris Calorific Co. agency and carry a complete line of "Harris" products in stock, and in addition sell a complete line of supplies for both oxy-acetylene and arc welding. Mr. Beckham was for many years with the Modern Engineering Co., and Mr. Sabin, the other partner, was formerly with the engineering department of the city of Memphis.

The Pittsburgh office of The Lincoln Electric Co., formerly at 323 Fourth

New Quarters of Lincoln Electric Co. in Pittsburgh.

Ave., has been moved to larger quarters at 926 Manchester Blvd., a few minutes' drive from the heart of the city. The new location contains 1000 sq. ft. of floor space for storing and displaying arc-welding equipment, electrodes and supplies. F. M. Maichle is district manager. The opening of the new office marks the beginning of the 19th year during which the company has maintained direct sales representation in the Pittsburgh territory.

The Major Engineering Works, Des Moines, Iowa, are moving April 1st into the heart of the heavy commercial district of the Capitol City. The new address will be 312-14 Second St., where they have obtained two floors aggregating 10,000 sq. ft. of space. They warehouse a full line of supplies and equipment for arc welding and metal spraying.

J. D. Wright and Karl H. Runkle have been appointed assistant managers of the General Electric Co.'s industrial department. Prior to their promotions, Mr. Wright was assistant head of the department's engineering staff and Mr. Runkle was manager of sales of the department's mining and steel-mill section.

Their policy of loaning torches and regulators without charge while Torchweld apparatus is in the factory for repairs, is specifically being called to the attention of their customers by the Torchweld Equipment Co., 1035 W. Lake St., Chicago, Ill.

FlexArc welding equipment is now being handled by the Duis Electric Co., Streator, Ill., and the American Machinery & Supply Co., Omaha, Nebr., according to an announcement from the Chicago office of the Westinghouse Electric & Manufacturing Co.

R. J. Southwell, for many years associated with the Wickwire-Spencer Steel Co., is now connected with the American Chain Co., Inc., and associated companies in the capacity of sales engineer. His headquarters are at Bridgeport, Conn.

Application for listing of the capital stock of Compressed Industrial Gases, Inc., has been approved by the Chicago Stock Exchange. This company, which was formed in 1928, has earned profits and paid dividends every year.

The Wayne Welding & Supply Co., Ft. Wayne, Ind., have been appointed distributors for the Westinghouse FlexArc a.c. and d.c. arc welders, and Phos-Copper and the company's complete line of welding accessories.

Steel Sales Corp., 129 S. Jefferson St., Chicago, Ill., has been appointed distributor for Phos-Copper low-temperature brazing alloys, made by the Westinghouse Electric & Manufacturing Co.

Notes From the Field

The Bethlehem Steel Co. was reported low bidder on 10,000 tons of carbon-arc-welded pipe for the city of St. Louis, in connection with the municipal water-supply system. Bethlehem recently completed an order for 8,000 tons of similar pipe for the same project. If the order is received, the pipe will be manufactured at the Leetsdale, Pa., works below Pittsburgh on the Ohio River. On the former order, 60, 54 and 48-in.-diameter pipes of varying lengths were furnished.

The St. Louis Shipbuilding & Steel Co. has been awarded a contract by the Tennessee Valley Authority of Knoxville, Tenn., for the construction of four all-welded steel deck barges, 110 ft. long, 26 ft. wide and 6.6 ft. deep, on their low bid of $6,960. The Ingalls Iron Works of Birmingham, Ala., was awarded a contract for the building of a ferry barge by the same authority on its low bid of $6,450. Both are to be completed in 45 days and are to be delivered to the Gunthersville dam, Tennessee River.

The Gulf Refining Company of Pittsburgh is reported to be in the market for several more tank barges for inland

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rivers and the Great Lakes. It is believed that welded construction will be purchased, as the company leans toward that type of equipment. One of the inquiries is for a non-propelled tank barge for use on inland waterways, while the other calls for one or two barges, for the transportation of petroleum products on the Great Lakes and the Erie Canal. The latter specifications are reported as 208 ft. in length, 41 ft. wide and 13 ft. deep.

The address of the Atomic Welders, Inc., is 111 Brady St., Detroit, Mich., which is a correction of the address given in a news item in the February issue of *The Welding Engineer*. The officers of this new firm are: Harold Sheldon, president; Joseph Catte, secretary and treasurer; and Percy Cunningham, vice-president. Mr. Sheldon and Mr. Catte were formerly with the Hudson Motor Car Co. The company is specializing in tool and die welding with the atomic-hydrogen process.

Auctions of farm machinery, and fairs, have proved profitable to one welding-shop operator, who makes it a practice to be on the job and repair broken parts. He carries complete oxy-acetylene-welding equipment, also grinding wheels, jigs and fixtures, a vise and other tools, on a trailer. At one auction, he found fifty broken parts in forty machines being put up for sale. One of these was a corn harvester having three broken cast-iron gears, which he welded for the purchaser.

The Pittsburgh office of the United States Army Engineers has been authorized to conduct inspection of ten 20-ft. lengths of electrically welded dredge pipe being manufactured at the Leetsdale, Pa., works of the Bethlehem Steel Co., and 264 19-ft. lengths of 18-in. dredge pipe manufactured by the Youngstown Sheet & Tube Co. at its Youngstown, O., plant. This pipe is for use in the Philadelphia district.

A $200,000 plant employing a great amount of welding both in its erection and in the production of its products, is to be built in Baldwin Park, Calif., by the United Concrete Pipe Corp. The plant will be used for the manufacture of precast concrete pipe for the Metropolitan Water District Parker Dam project. This pipe will all be of large diameter and will be heavily reinforced with welded steel.

More than 4,200 lb. of Allegheny stainless steel were used in the fabrication of a giant milk storage tank recently constructed for the Dean Milk Co. of Chemung, Ill. The tank, of welded construction, was fabricated by the Alloy Products Corp. of Waukesha, Wis., according to Clark W. Green, of the alloy sales division of the Allegheny Steel Co., Breckenridge, Pa.

The Union Oil Co. of California has just completed the construction of an 8-in. welded oil line in the Edison oil field. The Macco-Robertson Co., contractors for the job, are now commencing the work of laying a 16-in. gas line to run from the Industrial Fuel Co.'s booster plant at Mt. View to the Standard Oil Co.'s compressor plant in the Mt. View field.

The Pittsburgh office of the United States Army Engineers has completed inspection and permitted the shipping of 33 miles of 6-in. welded steel pipe from the plant of the Wheeling Steel Corp., Wheeling, W. Va., to the United States Engineers at Tucumcari, N. M. Approximately 2,500 tons of steel were required in its manufacture.

Indications of a continuance of the upward swing in the welding industry on the Pacific coast are confirmed in recent orders for 13,350 tons of steel bars for reinforcing precast concrete pipe for the great Colorado River aqueduct. Welding is used extensively in the fabrication of the steel framework of this reinforced pipe.

It is reported in barge-building circles that the Nashville Bridge Co. has been awarded a contract for two welded steel barges for the American Oil Co., for which 500 tons of steel plates and shapes will be required. They will be 180 ft. long, 35 ft. wide and 9 ft. deep, with a capacity of 7,500 barrels each.

The Federated Metals Corp., subsidiary of the American Smelting & Refining Co., has disclosed plans for the construction of a new plant at 26th St. and Indiana Ave., Los Angeles. The corporation is one of the largest manufacturers of non-ferrous metals in the United States.

A large number of welders will be given employment in the erection and operation of the nation's second largest automobile assembly plant now under construction by the General Motors Corp. in South Gate, Calif., a suburb of Los Angeles.

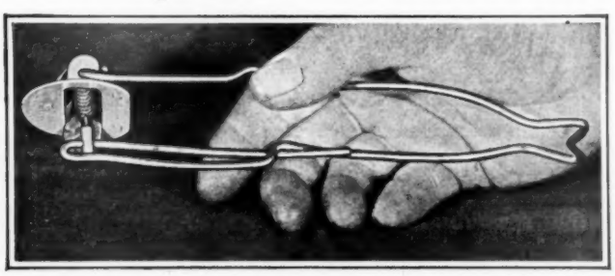
The Kingston Lake Gravel Co. of Mapleton, Ill., has awarded a contract to the St. Louis Shipbuilding Co. for a fleet of four welded steel barges. They will be of the flush-deck, cargo-box type and will be 130 ft. long, 32 ft. wide and 7 ft. deep.

Welding held a prominent place in the power show which was held at the Peoria, Ill., State Armory, on March 5, 6 and 7. Thirty exhibits of power machinery and products were on display, the show being sponsored by Hagerty Bros., of 923 South Washington St.

A. Thuillier, formerly operating a welding and machine shop at 1344 W. Slauson Ave., Los Angeles, Calif., has opened a larger and more fully equipped shop at 2956 S. Western Ave., in Los Angeles.

Sokolis Bros., of Springfield, Ill., are opening up a new shop under the name of Guarantee Welding Shop.

The Improved "Round File" Gas Lighter



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